THE PSYCHOLOGICAL NEED FOR SAFETY AT WORK:

A CYBERNETIC PERSPECTIVE

A Dissertation

by

JEREMY MARK BEUS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2012

Major Subject: Psychology

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ABSTRACT

The Psychological Need for Safety at Work:

A Cybernetic Perspective. (May 2012)

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Despite an increased understanding of the individual and contextual factors that influence both employee safety behavior and workplace safety incidents (e.g., injuries, accidents), there has been surprisingly little theoretical or empirical consideration of the individual employee's psychological experience of safety at work. Given that feeling safe is widely theorized to be a basic psychological need with implications for individual well-being and safety-related work behavior, the purpose of this dissertation was to use cybernetic theory—a conceptual framework that explains self-regulation through negative feedback processes—to explore both the antecedents and outcomes of individuals' perceived safety at work. Theory-based hypotheses were tested in a field sample of 595 production employees and their foremen at three weapons production sites in the southern United States. Results revealed that psychological safety climate and perceived job risk were both meaningful correlates of workers' perceived safety whereas personality variables (i.e., trait anxiety, safety locus of control) and personal safety knowledge were not meaningful correlates. Consistent with cybernetic theory, lower perceived safety was associated with increased safety-related anxiety. However, contrary to theoretical expectations, safety-related anxiety did not share consistent, positive associations with self- or foreman-rated safety behaviors. There was limited support, however, which suggested that safety-related anxiety is positively associated with self-reported safety participation behaviors. The implications of these findings in conjunction with a number of explorative analyses are discussed and recommendations for future research are provided.

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INTRODUCTION

It is well known that the breach of workplace safety can have drastic individual and organizational consequences. This point is easily illustrated when considering that in the United States alone in 2010, there were 3.06 million *reported* injuries and more than 4,500 workplace fatalities (Bureau of Labor Statistics, 2011). In addition, the economic cost of workers' compensation was estimated to be greater than $50 billion in 2009 (Liberty Mutual Research Institute for Safety, 2011), and this does not take into account the costs of replacing injured workers or the costs associated with a damaged organizational reputation (e.g., Deepwater Horizon; Macalister, 2010).

Although recent meta-analyses evidence an ever-increasing understanding of many of the individual (e.g., personality traits, job attitudes) and contextual factors (e.g., safety climate, job characteristics) that affect both safety behavior and safety incidents (e.g., Beus, Payne, Bergman, & Arthur, 2010; Burke et al., 2011; Christian, Bradley, Wallace, & Burke, 2009; Nahrgang, Morgeson, & Hofmann, 2011), we still have little to no understanding of the psychological meaning of safety to the individual worker. That is, despite knowledge of factors that influence important safety outcomes, we scarcely understand what it means psychologically for the individual employee when the need for safety is (un)met at work and what implications this has for subsequent employee well-being and safety-related work behaviors. Indeed, even scholarly books and chapters that have been devoted to the psychology of workplace safety (e.g., Barling & Frone, 2003;

This dissertation follows the style of *Journal of Applied Psychology.*

Geller, 2001; Kaplan & Tetrick, 2010) have hardly, if at all, broached the subject of what safety means from the individual's perspective. Consequently, this study contributes to the extant occupational safety literature by exploring the implications of what it means to feel (un)safe at work. Specifically, using cybernetic theory (cf. Edwards, 1992; Miller, 1965) as a conceptual framework, this study examines the individual and contextual factors that inform perceived safety as well as the mechanisms through which perceived safety is posited to affect worker well-being and safety-related work behaviors. The examination of this intuitively simple construct addresses a striking omission in the occupational safety literature and brings a needed focus to individual workers and their subjective experience of safety.

This dissertation is organized as follows. First, before addressing the subjective experience of perceived safety, objective or actual safety is discussed—this is a phenomenon that is generally left undefined and unscrutinized but is important for a basal understanding of perceived safety. Second, perceived safety is introduced as an appraisal of need fulfillment. Cybernetic theory is then used to explain both how workers' perceived safety is formed and what implications perceived safety has for worker well-being and safety-related work behavior. Finally, the method, results, and implications of a field study designed to investigate these phenomena is discussed.

Actual Safety

Safety is almost universally left undefined in the organizational sciences and elsewhere. Although perhaps colloquially understood, a formal definition of what safety is offers needed theoretical clarity that is prerequisite to examining *perceived* safety. As a lay definition of the construct, safety can simply be described as a state of freedom from harm or danger (Dictionary.com, 2010). It is noteworthy that safety is not merely the *absence* of harm, but the *freedom* from harm. Whereas the former is a necessary precondition to the latter, the apparent absence of current harm does not preclude future harm. Reason's (1990; 2000) Swiss cheese model of accident causation explains why this is true and, consequently, why safety cannot be inferred from the absence of incidents.

In his model, Reason (1990; 2000) likened an organization's defensive barriers against safety incidents to slices of Swiss cheese. Like the cheese, each of an organization's defensive barriers has holes, or weaknesses. These holes are posited to have two primary causes: active failures and latent conditions. Active failures are unsafe acts which directly affect a barrier's defenses, whereas latent conditions are the weaknesses inherent within an organization (Reason, 2000). Generally, for safety-related incidents such as accidents or injuries to occur, active failures and latent conditions must coincide (i.e., the "cheese holes" must align). However, because this alignment is often rare and at times due to a combination of factors that are not immediately transparent or known (Hulin & Rousseau, 1980; Jacobs, 1970; Reason, 2000), accidents and injuries often do not occur in conjunction with unsafe behaviors or faulty organizational safeguards. Thus, the absence of accidents, injuries, and other explicit evidences of breached safety are deficient as indicators of safety. Their absence does not accurately signify the *presence* of safety, or freedom from future harm; rather, accidents and injuries can only indicate the *absence* of safety (Tarrants, 1970) and imperfectly so given that unsafe behavior and accidents usually do not co-occur (Reason, 1990; 1995). Conversely, although potentially positive indicators such as safety behavior or safety climate can denote the presence of safety to some degree, these factors are also deficient in that they are unlikely to fully represent the extent to which an individual or workplace is free from future harm.

In sum, actual safety is characterized by both the absence of harm and the extent to which an individual or workplace is free from future harm. However, because the myriad threats and contributors to workers' safety are impossible to comprehensively identify in any given workplace and for every individual worker (Jermier, Gaines, & McIntosh, 1989; McLain, 1995), direct estimates of objective or actual safety are infeasible; thus, the presence of safety must be inferred indirectly (Jacobs, 1970; Reason, 1995). Furthermore, although actual safety represents the extent to which a worker is truly free from harm, it is a person's perceived safety, not the true state per se, that has psychological and behavioral implications. Consequently, this study's focus is on safety as it is perceived by the individual worker.

Perceived Safety

If actual safety is the extent to which individuals are truly free from harm or danger, perceived safety represents individuals' subjective appraisals of the same. That is, perceived safety is the extent to which individuals perceive that their need to be free from harm is satisfied. Although it is unarguable that *being* safe is a basic physiological need given its necessity for prolonged survival, *feeling* safe is widely theorized to be a basic psychological need as well (Higgins, 2000; Maslow, 1943; Pittman & Zeigler, 2007; Pyszczynski, Greenberg, & Solomon, 1997). Given that people are inherently aware of their need for physical safety (Pittman & Zeigler, 2007; Pyszczynski et al., 1997), there is likewise a psychological need to perceive that the physical need for safety is being fulfilled. Feeling safe, regardless of whether it is objectively true, is vital for psychological well-being because it represents individuals' evaluations of their likelihood for continued health or survival. Considering the *perception* of being safe as a need is consistent with Deci and Ryan's (2000) definition of needs as "innate psychological nutriments that are essential for ongoing psychological growth, integrity, and well-being" (p. 229).

A number of diverse motivational theories have posited perceived safety to be a basic psychological need. For example, in Maslow's (1943) well-known need hierarchy theory, safety is a basal need, secondary only to immediate physiological needs such as food, water, and oxygen. In Higgins' (2000) regulatory focus theory, individual self-regulation is posited to differ based on whether it is serving the fundamental needs of nurturance (i.e., development or growth) or security (i.e., safety and protection). Based on this theory, a focus on the need for safety and security (i.e., a prevention focus) motivates behaviors that are directed towards avoiding mismatches to the desired end-state of feeling safe (Higgins, 1997; 1998). Additionally, terror management theory posits the need for self-preservation (i.e., safety) to be the overarching human motive from which most other psychological needs are derived (Pyszczynski et al., 1997). In sum, these varied motivational theories underscore the importance of considering perceived safety as a basic psychological need.

A person's perceived safety should vary based on context. That is, a person is likely to have differing safety perceptions at home, at work, while traveling, in a dark alley, and so on. These perceptions would also be expected to vary within contexts to some extent such that at work, a person may feel safer performing certain tasks over others, or working with some coworkers relative to others. However, these within-context instances in which safety varies should inform more meaningful, overarching appraisals of safety given the general human tendency toward cognitive frugality and heuristic judgments (Fiske & Taylor, 1991; Gigerenzer & Goldstein, 1996; Kahneman, Slovic, & Tversky, 1982). For the purposes of this study, perceived safety is examined as an overall appraisal at work, or the extent to which individuals believe they are generally free from harm in their workplace. Given the prominent role work plays in most individuals' lives, perceived safety at work should have important implications for individuals' well-being and safety-related work behaviors.

What Perceived Safety is Not

Because of the conceptual ambiguity and inconsistency that exists in much of the extant occupational safety literature (Christian et al., 2009), it is important to distinguish perceived safety from a number of other safety-related constructs. Explicating *what perceived safety is not* is valuable for both concurrent and future conceptual coherence. Accordingly, I describe how perceived safety is different from the related constructs of perceived risk, perceived job risk, psychological safety climate, and safety attitudes.

Perceived risk (at work). Based on conceptual similarity, the most noteworthy construct to differentiate perceived safety from is perceived risk. Morrow and Crum

(1998) described perceived risk simply as perceived dangerousness. More commonly, however, perceived risk is conceptualized as individuals' subjective estimates of their likelihood of being harmed in a particular activity or their likelihood of experiencing an adverse event (e.g., Johnson & Tversky, 1983; McLain, 1995; Weinstein, 2000). Thus, whereas perceived safety is the extent to which individuals believe they are free from harm, perceived risk is essentially the extent to which individuals believe they are likely to be harmed. Based on these definitions, perceived safety and perceived risk seem to be approximate conceptual opposites, although some have claimed otherwise. For example, Rochlin (1999) asserted that safety is a positive construct and not simply the opposite of risk. Thinking of perceived risk as a measure of the potential for error, Rochlin contended that "defining an organization as safe because it has a low rate of error or accident has the same limitations as defining health in terms of not being sick" (Rochlin, 1999, p. 1555). Just as an individual who lacks an illness is not necessarily healthy, a lack of risk does not inevitably guarantee the presence of safety. This suggests that perceived safety and perceived risk are not simply opposites on the same pole. Nevertheless, even if perceived risk is the *conceptual* opposite of perceived safety, it has not been measured as the empirical opposite in the organizational sciences. A consideration of how perceived risk has been confounded with perceived *job* risk illustrates this point.

Perceived job risk. Often confused with perceived risk, and likewise distinct from perceived safety, is *perceived job risk*. Although not always labeled distinctly from perceived risk, perceived job risk is an individual's appraisal of the level of riskiness inherent to their job, and not necessarily the level of risk they personally feel when working. The few safety-specific studies on perceived risk that have been conducted in the organizational sciences have actually used items that assess perceived *job* risk, not perceived risk, or the extent to which individuals truly feel they are at risk when at work (e.g., Jermier et al., 1989; Morrow & Crum, 1998). For example, items from Jermier et al. (1989) include “I encounter personally hazardous situations while at work” and “my job is physically dangerous” (p. 22). Individuals who perform inherently risky or dangerous work (e.g., firefighters, police officers, high-rise construction workers) would naturally be expected to agree with these statements. However, it is entirely possible for these same individuals also to feel safe (or not at risk) when working despite known risks because the necessary safeguards have been accounted for. For example, if a firefighter knows he has a teammate tethered to him while he enters a smoke-filled building, he may feel safe (from a relative standpoint) despite the surrounding dangers. Likewise, a construction worker who trusts the reliability of the harnesses and equipment that prevent falls may feel safe even when working at great heights. These illustrations underscore the needed distinction between perceived safety (and perceived risk at work) and perceived job risk. It is important to note, however, that this conceptual distinction does not imply that there is no association between perceived safety and perceived job risk. On the contrary, as I discuss in more detail later, perceived job risk should be a meaningful antecedent of perceived safety. Certainly individuals are expected to use what they know about the riskiness of their work environment to form their own appraisal of the extent to which they are free from harm. Thus, although distinct, it is noteworthy that these two constructs remain theoretically related.

Psychological safety climate. Psychological safety climate is an individual's perception of workplace safety policies, procedures, and practices (Ostroff, Kinicki, & Tamkins, 2003; Zohar, 2003). It can more generally be considered an individual's appraisal of safety's priority in the organization (Zohar, 2000). The key difference between this construct and perceived safety is that psychological safety climate is an individual's appraisal of the extent to which safety is prioritized by external constituents (e.g., supervisors, coworkers), whereas perceived safety is an internalized appraisal of the extent to which the basic need for safety is being satisfied. Like perceived job risk, psychological safety climate should be a meaningful antecedent that informs perceptions of safety. However, although related, these two constructs are theoretically distinct and should be considered separately.

Safety attitudes. Henning et al. (2009) described safety attitudes as beliefs individuals hold pertaining to safety. Example items used to assess this construct include "working safely should be a condition of employment" and "companies should be as concerned for safety as for profit" (Henning et al., 2009, p. 341). Thus, rather than an appraisal of feeling (un)safe, safety attitudes reflect opinions regarding how safety ought to be considered or handled.

In sum, because none of the aforementioned constructs represents a direct appraisal of the fulfillment of the psychological need for safety at work, it is important that they be treated separately both conceptually and empirically from perceived safety.

These distinctions were outlined to ensure future conceptual clarity with regard to perceived safety. Next, I discuss how cybernetic theory provides a conceptual framework for considering both how perceived safety is informed at work and what implications perceived safety has for individual well-being and behavior.

Cybernetic Theory as a Framework for Understanding Perceived Safety

The premise of cybernetic, or control theory (Carver & Scheier, 1982), is that living organisms are self-regulating systems that are motivated to maintain desired states of equilibrium or homeostasis (Cummings & Cooper, 1979; Edwards, 1992; Miller, 1965). In order to achieve equilibrium, where deviations from desired states are minimized, individuals use a process of negative feedback to self-regulate (Cummings & Cooper, 1979). In negative feedback, relevant information is gathered to allow individuals to compare a current state with a desired state; when a discrepancy is detected, actions are taken to eliminate the discrepancy which then leads to re-evaluation of the current state relative to the desired state. The process then repeats itself until equilibrium is ultimately attained (Edwards, 1992). Cybernetic theory has been posited to have wide explanatory power for human behavior, both in general (Carver & Scheier, 1982; Miller, 1965) and in work or organizational contexts specifically (Cummings & Cooper, 1979; Edwards, 1992). Although never explicitly considered with regard to perceived safety, the cybernetic process has clear application when considering both how safety perceptions are formed and what implications those perceptions have for well-being and behavior.

In considering the cybernetic process applied to safety, there are a number of theoretical assumptions that should be addressed (cf. Cummings & Cooper, 1979). First, cybernetic theory assumes that we prefer one state (safety) over another (the lack thereof). Although the degree of safety one individual prefers relative to another is likely to differ, safety is ultimately a basic need that should be sought by all at some level (Maslow, 1943; Pittman & Zeigler, 2007; Pyszczynski et al., 1997). Second, this framework assumes that we have knowledge of our current state or that we are capable of judging our current level of safety. It is important to note that this does not assume that "knowledge" of our current safety is accurate—rather, that we are capable of reaching a judgment (accurate or otherwise) of our current level. The third assumption is that we can compare our current and desired states. This assumption is tightly yoked with the previous as perception of one's current state has little meaning unless that current state is considered relative to a desired state (Carver & Scheier, 1982). Fourth, cybernetic theory assumes that perceived discrepancies are psychologically troubling—it is noteworthy that this is only expected to be the case when the discrepancy is considered important (Edwards, 1992). This assumption is deemed appropriate for perceived safety given its role as a basic psychological need. Finally, cybernetic theory assumes that discrepancy-induced strain will motivate individuals to adopt strategies to eliminate the discrepancies (Cummings & Cooper, 1979; Edwards, 1992).

Operating under these assumptions, cybernetic theory should be able to explain how individuals self-regulate with regard to their perceived safety at work. To add greater specificity to the cybernetic explanation of perceived safety, specific contextual and individual factors that should inform perceived safety were considered, as well as perceived safety's influence on safety-related anxiety and subsequent safety-related work behaviors. Figure 1 provides a graphic illustration of the cybernetic process applied to perceived safety and provides a basic framework outlining the major variables considered in this study.

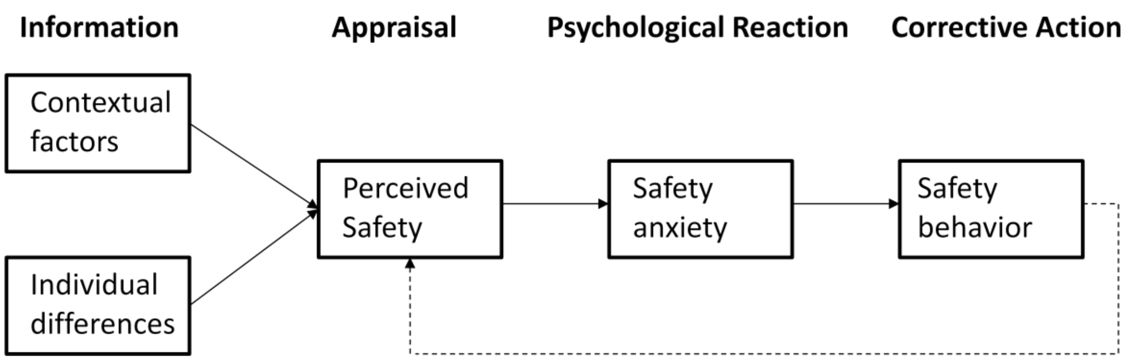

Figure 1. Cybernetic theory applied to perceived safety.

Contextual Antecedents of Perceived Safety

Individuals are theorized to gather relevant contextual information from cues around them to form their perceived safety at work. Because safety constitutes both the lack of current harm and the freedom from future harm, individuals are expected to use the accessible information that allows them to infer both. Thus, workers should use direct evidence of breached safety (e.g., injuries) as well as other indicators concerning the likelihood of future freedom from harm (e.g., psychological safety climate) as the bases of their perceived safety at work. The contextual factors that are hypothesized to inform individuals' perceived safety at work are delineated in the subsections that follow.

Knowledge of workplace injuries. Arguably the most salient evidence of breached safety at work is the occurrence of an injury. A workplace incident that results in personal injury clearly demonstrates at least a temporary lack of safety. Such incidents, even when relatively isolated, should decrease workers' perceived safety given that they plainly show that there is a possibility of being harmed. More regular or systematic occurrences of such incidents should only serve to further decrease perceived safety as they suggest a lesser degree of freedom from harm. Although the personal experience of being injured is likely the most meaningful evidence of breached safety, learning about or witnessing co-workers' injuries, whether through formal channels (e.g., organizational announcements) or informal ones (e.g., hearsay), should likewise lessen perceived safety. Even without personal involvement, the knowledge that others have been harmed while at work represents meaningful contextual information that should influence perceived safety. Thus, knowledge of workplace injuries, whether gained through personal experience or observation or whether learned of indirectly, should be negatively associated with perceived safety such that more known injuries are associated with lower perceived safety.

Hypothesis 1: Knowledge of workplace injuries, whether experienced, witnessed, or learned, is negatively related to perceived safety in the workplace.

Perceived job risk. As discussed, perceived job risk is an appraisal of the risk or danger inherent to the conduct of work or the physical environment in which the work is conducted. Whereas knowledge of injuries can be used to infer a current or recent lack of safety, perceived job risk can be used to infer the likelihood of *future* injury, or a future lack of safety on the job. Even when no known injuries have occurred in recent history, a person's perceived job risk, born of industry and job knowledge, personal experience, and social influence processes (Burke et al., 2011), should be instrumental in helping workers to formulate a reasonable estimation regarding their current safety. Thus, perceived job risk and perceived safety should be negatively associated such that workers who perceive greater levels of job risk should also have lower perceived safety.

Hypothesis 2: Perceived job risk is negatively related to perceived safety in the workplace.

Psychological safety climate. Like the perceived riskiness inherent to the conduct of work or the environment in which the work is performed, psychological safety climate constitutes a context-based perception that should inform individuals' perceived safety. Psychological safety climate, a worker's appraisal of the extent to which safety is valued and prioritized by both management and fellow coworkers, is formed through interactions with supervisors and coworkers and by observing whether safety-related behaviors are supported or reinforced (Ostroff et al., 2003; Zohar, 2003). The extent to which workers perceive that safety is supported and reinforced by their workgroup or organization should likewise communicate to them the extent to which they will be free from harm in the future. Indeed, the negative association between safety climate and subsequent injuries that has been demonstrated meta-analytically (Beus et al., 2010) suggests that psychological safety climates are reasonable predictors of future safety, or a lack thereof. Consequently, I posit that psychological safety climate is positively associated with perceived safety such that more favorable psychological safety climates are associated with greater perceived safety.

Hypothesis 3: Psychological safety climate is positively related to perceived safety in the workplace.

Person-Related Antecedents of Perceived Safety

Whereas workers are expected to use the above-mentioned contextual cues to form their perceptions of safety, there are individual differences that theoretically should affect perceived safety largely independent of the surrounding context. A number of individual differences have demonstrated meaningful associations with safety-related behavior and outcomes (e.g., conscientiousness, emotional stability; Christian et al., 2009; Clarke & Robertson, 2005). Likewise, there are person-related factors that theoretically should affect individuals' perceived safety. Individual differences relevant to perceived safety that have demonstrated direct application to past occupational safety research include trait anxiety (a key facet of emotional stability; Goldberg, 1992; McCrae & Costa, 1987), locus of control, and safety knowledge (e.g., Christian et al., 2009; Matthews & MacLeod, 1985). These constructs are considered for the purposes of this study because of their proximal theoretical relevance to perceived safety and because they have established nomological networks (cf. Bruk-Lee, Khoury, Nixon, Goh, & Spector, 2009; Christian et al., 2009; Judge & Bono, 2001; Wang, Bowling, & Eschleman, 2010) that can help position perceived safety within a broader constellation of constructs. This is of particular value given that this study represents an initial examination of the perceived safety construct. Consequently, trait anxiety, locus of control, and safety knowledge are discussed in turn to address their distinctive theoretical contributions to perceived safety.

Trait anxiety. Trait anxiety, or a generalized tendency toward feeling apprehensive, worried, or fearful, is a component of the more expansive trait of emotional stability (Goldberg, 1992; McCrae & Costa, 1987) which has demonstrated meaningful meta-analytic associations with workplace accidents and injuries (Christian et al., 2009; Clarke & Robertson, 2005). A predisposition towards anxiety has direct implications for perceived safety given that feeling apprehensive or worried is naturally at odds with feeling safe. Indeed, past research has shown that generalized anxiety leads to greater sensitivity to threat cues such that more anxious individuals are more likely to selectively attend to potential threats or dangers in their environment (Gallagher, 1990; Mathews & MacLeod, 1985). A greater preoccupation with threats to personal safety in the workplace should likewise reduce perceived safety. Thus, independent of contextual factors, trait anxiety should be negatively related to perceived safety such that individuals higher in trait anxiety will tend to have lower perceived safety at work relative to individuals lower in trait anxiety.

Hypothesis 4: Trait anxiety is negatively related to perceived safety in the workplace.

Locus of control. Locus of control reflects the extent to which people tend to believe that the events in their lives are personally controlled (i.e., contingent upon their own behaviors) versus being controlled by external forces such as luck, fate, or powerful others (Rotter, 1966). Belief in personal control over life events characterizes an internal locus of control, whereas a belief that events are controlled by outside forces characterizes an external locus of control (Rotter, 1966). Locus of control is conceptualized as a hierarchical construct with general locus of control existing at the highest level and domain or context-specific loci of control residing at lower hierarchical levels (Chen, Goddard, & Casper, 2004; Rotter, 1975; Wang et al., 2010). Examples of domain-specific loci of control include work locus of control (e.g., Wang et al., 2010), health locus of control (e.g., Wallston, Wallston, Kaplan, & Maides, 1976), driving locus of control (Montag & Comrey, 1987), and safety locus of control (e.g., Jones & Wuebker, 1985). Because the focus of this study is workplace safety, safety locus of control will be considered here, as opposed to general locus of control. In support of this, Jones and Wuebker (1993) found only a moderate association between general and safety locus of control, suggesting that safety locus of control may have unique explanatory power relative to general locus of control.

Past research has shown that safety locus of control is associated with both safety behavior and the occurrence and severity of accidents and injuries (Christian et al., 2009; Jones & Wuebker, 1985; 1993). These studies suggest that individuals with an internal safety locus of control tend to work more safely and are involved in fewer and less severe accidents and injuries relative to individuals with an external safety locus of control (Christian et al., 2009; Jones & Wuebker, 1985). Workers' safety locus of control should influence their perceived safety given that a person who believes they have control over workplace safety is likely to feel safer due to greater confidence that events (or non-events) are contingent upon their behaviors. That is, individuals with an internal safety locus of control are more likely to believe that maintaining personal safety is within their power. Conversely, individuals with an external safety locus of control who believe workplace accidents or injuries are beyond their control should feel more susceptible to harm and thus have lower perceived safety. Accordingly, safety locus of control should be positively related to perceived safety such that greater safety locus of control (i.e., a more internal locus) is associated with greater perceived safety.

Hypothesis 5: Safety locus of control is positively related to perceived safety in the workplace.

Safety knowledge. Although trait anxiety and safety locus of control should both exert largely unconscious influences on workers' perceived safety, safety knowledge represents workers' conscious appraisal of the extent to which they know how to remain free from harm at work. Building off of Campbell, McCloy, Oppler, and Sager's (1993) theory concerning the three determinants of general job performance, Griffin and Neal (2000) posited that *safety* knowledge, in addition to skill and motivation, should likewise be a primary determinant of *safety* performance. Naturally, individuals can only work as safely as they know how to—although they may be motivated to work safely, they will be unable to if they are uninformed on the means of doing so. Knowing how to be safe at work thus has direct implications for workers' perceived safety. Workers who are aware that they lack the knowledge to follow all necessary safety protocol or use certain protective equipment should feel less safe given their reduced understanding of how to avoid or prevent future harm at work. Consequently, safety knowledge and perceived safety should be positively associated such that increased safety knowledge should correspond with greater perceived safety.

Hypothesis 6: Safety knowledge is positively related to perceived safety in the workplace.

Outcomes of Perceived Safety

In addition to explaining how perceptions of safety are formed, cybernetic theory also offers a framework for understanding how perceived safety should influence employee well-being and subsequent safety behavior. In the sections that follow, perceived safety is posited to directly influence worker safety-related anxiety which should in turn influence worker safety behavior (i.e., compliance and participation).

Safety-related anxiety (proximal outcome). Individuals who feel unsafe at work, whether or not it is true from an objective standpoint, will feel that their psychological need for safety is unsatisfied in that particular environment. In cybernetic terms, this represents a discrepancy or deviation from the desired state of feeling safe (Carver & Scheier, 1998; Lord, Diefendorff, Schmidt, & Hall, 2010). Cybernetic theory posits that the detection of such discrepancies is psychologically troubling and can lead to the experience of work strain (Cummings & Cooper, 1979; Edwards, 1992; Miller, 1965). A perceived safety discrepancy should be particularly troubling due to a greater perceived possibility of incurring physical harm. Such a realization should increase mortality salience and likewise enhance anxiety or distress at work (Pyszczynski et al., 1997). Consequently, perceived safety should be negatively associated with safety-related anxiety such that lower perceived safety is associated with greater levels of safety-specific anxiety.

Hypothesis 7: Perceived safety is negatively associated with safety-related anxiety.

Safety behavior (distal outcome). Worker safety behavior is theoretically a distal, indirect outcome of perceived safety that should operate as a coping mechanism in response to safety-related anxiety. Because individuals are inherently motivated to eliminate important discrepancies (Diefendorff & Chandler, 2011; Holroyd & Coles, 2002) and a perceived safety discrepancy is posited to increase safety-related anxiety (Pyszczynski et al., 1997), eliminating this discrepancy should be a particularly influential motivator of behavior. Thus, a person who perceives greater anxiety as a result of feeling unsafe should be motivated to engage in behaviors targeted at reducing that anxiety (Cummings & Cooper, 1979; Edwards, 1992). Specifically, individuals are expected to increase their own safety behaviors in an effort to alleviate the anxiety resulting from this discrepancy.

Like the recognized distinction between task and contextual job performance (Borman & Motowidlo, 1993), safety behaviors can be distinguished as directly contributing to core, required safety activities (e.g., wearing protective equipment) or as indirectly contributing to workplace safety through more discretionary means (i.e., attending safety meetings; Griffin & Neal, 2000). These safety behaviors are referred to as safety compliance and safety participation, respectively (Griffin & Neal, 2000). When feeling anxious due to low perceived safety, individuals are expected to engage in more safety compliance and participation behaviors to reduce their anxiety and feel safer. Enhancing one's own observance of designated work safety rules and regulations or working in more discretionary ways to promote workplace safety are direct ways individuals are expected to reduce a perceived safety discrepancy. Consequently, higher levels of safety-related anxiety should be associated with greater subsequent safety compliance and participation behaviors.

Hypothesis 8: Safety-related anxiety is positively related to (a) safety compliance and (b) to safety participation.

Summary of Hypotheses

In sum, the purpose of the posited hypotheses is to test the viability of a cybernetic framework applied to perceived safety. This study tests both context- and person-related correlates of perceived safety and also examines perceived safety's associations with safety-related anxiety and subsequent safety behavior. Figure 2 provides a graphic representation of this study's hypotheses. As can be seen, Hypotheses 1-3 pertain to proposed contextual antecedents of perceived safety and Hypotheses 4-6 concern person-related antecedents. Hypothesis 7 posits that safety-related anxiety is a proximal outcome of perceived safety and Hypotheses 8a and 8b posit safety compliance and safety participation as distal outcomes, respectively, in response to safety-related anxiety. Ultimately, testing these hypotheses contributes to the extant occupational safety literature by suggesting both how perceptions of safety are formed in the workplace and also what implications these perceptions have for worker well-being and safety behavior.

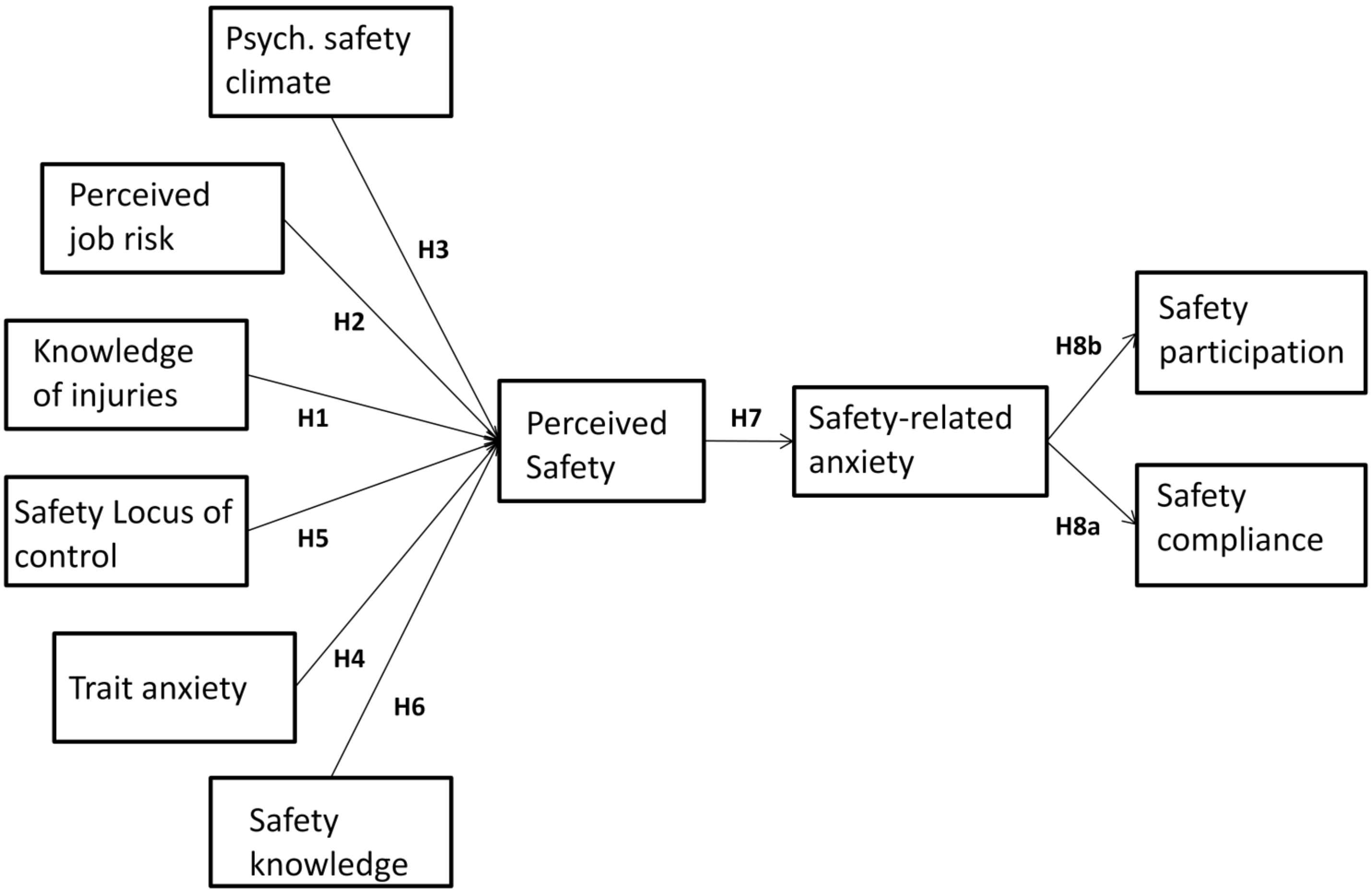

Figure 2. Summary of study hypotheses. H1 = Hypothesis 1 and so forth.

METHOD

Participants

Data for this study were collected from three unionized weapons production sites of a large defense company. The three sites are located in the southern United States. Participants across these three sites consisted of production employees and their respective foremen (i.e., immediate supervisors). Production employees were specifically targeted as participants because of the greater likelihood that they think about safety when working due to the safety-salient nature of their work (e.g., working with heavy machinery, dangerous materials). Across the three sites, 600 production employees completed surveys during a total of at least 21 separate employee meetings[1]; of these surveys, five were removed for clear patterns of careless responding (e.g., no variation in responses across the entire survey). Of the 595 useable responses (190, Site 1; 151, Site 2; 254, Site 3), 69% were completed by male respondents with an average age of 41.97 (*SD* = 12.86) years and an average organizational tenure of 7.55 (*SD* = 9.21) years.

A demographic breakdown of respondent characteristics by site is provided in Table 1. As can be seen, there is a marked difference in demographic characteristics in Site 1 relative to Sites 2 and 3. Specifically, Site 1 included a larger proportion of male respondents (84.90%) who tended to be older (*M* = 48.50 years, *SD* = 12.03) and who

[1] This number is based on the number of meetings that were directly verified in sites 1 and 3. Site 2 administered its surveys without reporting the number of meetings the surveys were administered in. The average number of employees who completed surveys in these meetings for sites 1 and 3 was 16.00 (*SD* = 6.67) and 28.44 (*SD* = 15.75), respectively. The average number of employees who completed surveys in each meeting across the two sites was (*M* = 21.33, *SD* = 12.79).

Table 1

Respondents' Demographic Characteristics by Site

Demographics	**Site 1** (n = 190)	**Site 2** (n = 151)	**Site 3** (n = 254)
Sex (% Male)	84.90[bc]	71.10[a]	72.60[a]
Age (M yrs)	48.50 (SD = 12.03)[bc]	35.99 (SD = 11.25)[ac]	40.47 (SD = 12.18)[ab]
Job experience (M yrs)	23.20 (SD = 12.04)[bc]	8.40 (SD = 9.42)[ac]	12.10 (SD = 10.95)[ab]
Tenure (M yrs)	12.80 (SD = 11.88)[bc]	3.76 (SD = 4.59)[ac]	5.71 (SD = 6.75)[ab]

Notes. Yrs = years; [a] Significantly different from Site 1, $p < .05$, two-tailed; [b] Significantly different from Site 2, $p < .05$, two-tailed; [c] Significantly different from Site 3, $p < .05$, two-tailed.

tended to have been in the organization longer (M = 12.80 years, SD = 11.88) compared to the other two sites.

Procedure

Production employee surveys. Production employees' data for this study were collected via a series of paper-and-pencil survey administrations. Employees at the participating work sites attend weekly meetings as workgroups to coordinate and discuss pertinent work-related issues (including safety). Survey measures were administered during one such meeting for each workgroup in September, 2011. In those meetings, a safety representative explained the general purpose of the survey and employees were then given time to complete the survey. Before starting the survey, employees were assured that their responses would be kept confidential and were encouraged to respond to all items honestly and to the best of their knowledge. This was communicated both verbally by the safety representative introducing the survey and in writing on the survey cover sheet.

After data collection, production employees' survey responses were entered into electronic form for statistical analyses by the author and three research assistants. To coordinate efforts and ensure accuracy of data entry, the author met with the research assistants to discuss the data entry process and all used a common instructions sheet. To check for accuracy early in the data entry process, each assistant re-entered a random subset of surveys from each of the other assistants. Of the 15 surveys that were re-entered, only one revealed a data entering discrepancy; this discrepancy was resolved by re-examining the survey in question.

Foremen ratings. Self-reported employee identification numbers were used to identify the corresponding foreman for each production employee. Of the 595 employees who provided useable surveys, 378 (64%) provided identification numbers on their surveys; see Table 2 for a demographic comparison of employees who did and did not report identification numbers; as can be seen, these comparisons suggest that these two groups of employees were not dramatically different in terms of demographic characteristics. Mean comparisons for employees who did and did not report identification numbers on selected core constructs are reported in Appendix A. Human resource representatives at each site then matched foremen to employee identification numbers. Once the corresponding foremen were identified for each employee, the foremen were individually invited via email by their site's environmental safety and health (ESH) director to participate in an online survey in which they were asked to rate the safety knowledge and safety behavior of some of their employees. They were then provided with a list of employee identification numbers to indicate which of

Table 2

Employee Demographic Comparisons Based on the Decision to Provide Employee Identification Numbers

Variable	**Provided ID** (*n* = 378)	**Did Not Provide ID** (*n* = 217)
Sex (% Male)	76.40	76.00
Age (*M* yrs)	43.13 (*SD* = 13.15)	39.25 (*SD* = 11.76)
Job experience (*M* yrs)	15.74 (*SD* = 13.13)	12.74 (*SD* = 10.81)
Tenure (*M* yrs)	8.17 (*SD* = 10.03)	6.16 (*SD* = 6.89)
Hours per week (*M*)	41.59 (*SD* = 4.46)	42.23 (*SD* = 5.24)
Supervisor (% Yes)	9.20	11.40

Notes. *M* = Mean; *n* = number of respondents; *SD* = standard deviation.

their employees to rate. Foremen were invited to rate their employees approximately one month after the production employee surveys were administered. The length of time between employee and foreman assessments reflects the length of time for these steps to be accomplished and does not represent a purposeful or theoretical decision.

Of the 57 foremen who were invited to participate across all three sites, 24 responded (42%) and rated a total of 83 employees (*M* = 3.19 [*SD* = 2.25] employees per foreman). However, one foreman's ratings were removed because of questionable response patterns. Specifically, there was no rating variation across or within the rated employees and an apparent misinterpretation of scale anchors (i.e., responded "1 – Strongly Disagree" to every item for every employee). The removal of this foreman's ratings resulted in 23 useable foreman responses and 75 total rated employees.

Measures[2]

All of the psychological constructs assessed in both the employee and foreman

[2] All of the variables assessed in this study and their items are listed in Appendix B.

surveys were assessed in blocks such that all items assessing a common construct appeared in groups as opposed to being mixed throughout the survey. The constructs are listed below, starting with the constructs assessed in the production employees' survey. Unless otherwise noted, all items were rated on a five-point agreement scale ranging from 1 "strongly disagree" to 5 "strongly agree."

Psychological safety climate. Psychological safety climate was assessed using a 30-item safety climate measure developed by Beus, Payne, and Arthur (2011). With items targeting perceptions of workgroup-level safety climates, this measure has demonstrated a consistent second-order factor structure and adequate dimension-level reliabilities (α = .90 - .97) across multiple samples with respondents from a diverse range of industries (Beus et al., 2011). The measure assesses content from seven first-order safety climate factors: management commitment to safety, safety communication, coworker safety practices, safety involvement, safety training, safety rewards, and safety equipment/housekeeping.

For the present sample, a second-order factor structure with seven first-order factors revealed a good fit to the data (χ^2 (398) = 1206.66; CFI = .94; RMSEA = .06; SRMR = .05). The coefficient alphas for the seven dimensions ranged from .82 (safety equipment/housekeeping) to .95 (management commitment to safety) suggesting good internal consistency for item responses within each dimension (M [α] = .88, SD = .04).

Trait anxiety. Trait anxiety was assessed using the 10-item International Personality Item Pool (IPIP) representation of Costa and McCrae's (1992) NEO-PI-R anxiety facet—one of six identified Neuroticism facets. Participants were asked to indicate the extent to which each item accurately described them on a five-point scale ranging from 1 “very inaccurate” to 5 “very accurate.” Past administrations of IPIP’s anxiety measure have demonstrated good internal consistency reliability ($\alpha = .83$) and strong correspondence to responses on the NEO-PI-R anxiety scale ($r = .75$; IPIP, 2011). In this sample, responses to trait anxiety revealed an alpha coefficient of .81, suggesting adequate internal consistency reliability.

Self-reported safety knowledge. Employees’ safety knowledge was assessed using Griffin and Neal’s (2000) four generalized safety knowledge items and two additional items created for specific application to the participating organization. Responses to these six items revealed a coefficient alpha of .78.

Perceived job risk. Perceived job risk was assessed using Jermier et al.’s (1989) three-item risk measure. Responses to these items revealed a coefficient alpha of .73 in the present administration.

Safety locus of control. Safety locus of control was assessed using Jones and Wuebker’s (1985) internal and external safety locus of control items. Although past studies have combined both sets of items into a single safety locus of control scale, poor item inter-correlations in previous administrations (cf. Cigularov, Chen, & Stallones, 2009) raise questions regarding the dimensionality of this scale. To test the dimensionality of this measure in the present sample, an exploratory factor analysis (EFA) using direct oblimin rotation was conducted; results revealed evidence of two separate factors when both scales were combined[3]. Consequently, these two scales were separated for the present study. The coefficient alphas for responses to the separated internal (6 items) and external (6 items) safety locus of control scales were .84 and .73, respectively.

Perceived safety. Perceived safety was assessed using a six-item measure developed for this study. The items were constructed to assess the degree to which workers feel safe, or free from harm, in their respective workplaces. Four of the six items were administered in two previous samples of workers. Specifically, the items were administered online to an employed student sample (*N* = 342; 44% male) and an international sample of employed respondents (*N* = 444; 53% male; 88% U.S. residents; see Beus et al., 2011 for administration details). Both samples revealed unidimensional factor structures and acceptable internal consistencies (α = .94 and .90, respectively). An example item is "I feel safe at my workplace." Despite favorable validity evidence from these previous administrations, two additional items were developed for this study to provide better representation of the content domain. Specifically, two items were developed to more directly assess perceived safety as an appraisal of need fulfillment. These items are "My need for safety is fulfilled at work" and "At work, my need for safety is satisfied." An EFA of responses to these six items' in the present sample confirmed a one-factor structure. Responses to these items also revealed good internal consistency with a coefficient alpha of .90.

[3] Safety externality items were reversed prior to running this analysis so that high scores for all items represented higher levels of internal safety locus of control.

Safety-related anxiety. Safety-related anxiety was assessed using a modified form of Marteau and Bekker's (1992) six-item version of the state scale of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970). Marteau and Bekker's (1992) shortened state anxiety measure has produced similar scores relative to the more expansive 20-item STAI state anxiety scale and previous administrations have also demonstrated adequate reliability ($\alpha = .82$). To assess *safety-specific* anxiety, the instructions for the measure were modified to prompt participants to respond to items with consideration of their general level of safety-related anxiety at work. Specifically, participants rated the extent to which the items were true with regard to their safety at work on a four-point scale ranging from 1 "Not at all" to 4 "Very much." It is noteworthy that a four-point scale was used for this measure to be consistent with the format of this scale used in previous analyses (e.g., Marteau & Bekker, 1992) and also as a means of reducing item anchoring effects that can lead to greater concerns of common method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Responses to this measure revealed a coefficient alpha of .80 in the present sample, suggesting adequate internal consistency.

Safety compliance and participation. Self-reported safety compliance (4 items) and safety participation (4 items) were assessed using items developed by Griffin and Neal (2000; Neal & Griffin, 2006). Responses to these items have demonstrated adequate internal consistencies in past research (safety compliance, $\alpha = .92$-$.93$; safety participation, $\alpha = .86$-$.89$; Neal & Griffin, 2006) and likewise revealed favorable internal consistency in the present sample (safety compliance, α = .92 and safety participation, α = .86).

Knowledge of injuries. Knowledge of workplace injuries was assessed using three items developed for this study. These items assessed knowledge of personally experienced injuries, witnessed injuries, and injuries learned of indirectly. These respective items and corresponding descriptive statistics are as follows: “How many times have you been injured in this job?” (M = .34, SD = 1.19), “How many times have you personally witnessed a co-worker getting injured on this job?” (M = .63, SD = 2.57), and “How many co-worker injuries have you learned about in this job that you did not personally witness?” (M = 2.12, SD = 5.21). Responses to these questions were summed to arrive at an overall estimate of workers’ knowledge of workplace injuries (M = 3.03, SD = 7.60).

Foreman Measures

Although production employees responded to paper-and-pencil surveys due to limited computer access, foremen were less constrained and were thus invited to rate their employees’ safety knowledge and behavior using an online survey instrument. The constructs included in the foreman measure are listed below. All items were rated on a five-point agreement scale ranging from 1 “strongly disagree” to 5 “strongly agree.”

Opportunity to observe safety behavior. A single item was included in the foreman survey to assess the extent to which foremen had adequate opportunity to observe of their employees’ safety performance prior to providing ratings. This was included solely as a means of verifying the appropriateness of foreman ratings. Foremen each responded to the item: “I have had sufficient opportunity to observe this employee’s safety performance.” The mean response for this item was 4.16 (*SD* = .87), suggesting that foremen generally agreed with the above statement.

Employee safety knowledge. As with employee-reported safety knowledge, foreman-rated employee safety knowledge was assessed using Griffin and Neal’s (2000) four generalized safety knowledge items and two additional items created for specific application to the participating organization. These items were altered slightly to reflect the fact that foreman were rating employees’ safety knowledge and not their own (e.g., “This employee knows how to perform his/her job in a safe manner”). Responses to these items had a coefficient alpha of .92. However, these items were assessed solely as a means of comparison with employee-reported safety knowledge. Because an employee’s self-reported safety knowledge (whether accurate or not) should be most influential on their perceived safety, foreman-reported safety knowledge was not used to test Hypothesis 7. Interestingly, the correlation between employee-reported (*M* = 4.34, *SD* = .50) and foreman-reported (*M* = 4.40, *SD* = .58) safety knowledge was -.06, suggesting no correspondence between employee and foreman ratings. It is worth noting, however, that there was minimal variance in both employee and foreman ratings of safety knowledge which may partially explain the lack of association between the two sources.

Employee safety compliance and participation. Griffin and Neal’s (2000) safety compliance (4 items) and safety participation (4 items) were also used to obtain foreman safety behavior ratings with the items being altered to reflect their non-self-report nature (e.g., “This employee carries out his/her work in a safe manner”). Responses to foreman-reported safety compliance and participation items revealed good internal consistencies (α = .94 and .87, respectively). Both employee-reported and foreman-reported safety behavior ratings were used to draw conclusions regarding Hypotheses 8a and 8b because foreman reports of employee behavior could provide additional evidence beyond self-reported safety behavior concerning safety-related anxiety’s associations with safety compliance and participation. Like safety knowledge, it is noteworthy that there was very little correspondence between employee-reported safety behaviors and foreman-reported safety behaviors (r = .05, safety compliance; r = .08, safety participation). It is possible, however, that this is a result of restricted variance in safety behavior ratings from both sources and that the two ratings are less divergent than suggested by these low correlations. A comparison of mean safety compliance (employee-reported, M = 4.34 [SD = .59; range = 3.00], versus foreman-reported, M = 4.45 [SD = .56; range = 2.25]) and safety participation ratings (employee-reported, M = 4.34 [SD = .64; range = 3.25] versus foreman-reported, M = 4.45 [SD = .65; range = 2.50]) across sources offers some support for this explanation.

Ancillary Measures – Employee-Reported

Impression management. Impression management was assessed using four items from the IPIP representation of the Personality Attributes Survey (PAS; Paulhus, 1991). This variable was not assessed to address any substantive hypotheses. Rather, impression management was included in the overall measure to allow exploratory examinations of the extent to which it shares associations with participants’ responses to substantive variables. This is one means of gauging the degree to which survey responses appear to be the product of impression management. These items revealed a coefficient alpha of .62 in the present sample, suggesting poor internal consistency. However, because the expected commonality among the items should solely be a pattern of socially desirable responding, the poor internal consistency suggests that impression management may not be a serious concern in this sample. Items were rated on a five-point scale ranging from 1 “very inaccurate” to 5 “very accurate.”

Safety threshold. Safety threshold was measured to test the core assumption that workers consider it important to feel safe at work. This variable was assessed solely as a means of affirming this theoretical assumption and was not included to test any formal hypotheses. Three items were created for this study to assess safety threshold. The internal consistency reliability of responses to these items was satisfactory ($\alpha = .84$).

Dutifulness. Dutifulness, a facet of conscientiousness, was assessed as an instrument variable to facilitate the proper estimation of this study’s non-recursive structural equation models. Instrument variables allow non-recursive models to be identified and should (a) share a direct, meaningful association with only one variable in a reciprocal relationship, (b) not be caused by either variable in the reciprocal association, and (c) be unrelated to unmeasured causes of the unrelated reciprocal variable (Edwards, 1992; James & Singh, 1978). Because this study incorporates an indirect feedback loop (where a variable mediates one direction of the reciprocal relationship), only one of the variables in the reciprocal relationship required an instrument variable for proper model identification (Kline, 2005). Consequently, the personality facet of dutifulness was selected as the instrument for this study because of its theoretical correspondence with employee safety behavior (i.e., compliance and participation) and because it likewise should not be directly associated with perceived safety or any unmeasured causes of perceived safety. Dutifulness was assessed using six items from the IPIP representation of Costa and McCrae's (1992) NEO-PI-R dutifulness facet. Participants indicated the extent to which each item accurately described them on a five-point scale ranging from 1 "very inaccurate" to 5 "very accurate." The coefficient alpha for responses to these items was .92.

Job satisfaction. Job satisfaction was assessed using the six-item shortened version of Brayfield and Rothe's (1951) 18-item global job satisfaction measure. Several past studies have demonstrated both validity and reliability evidence for the shortened measure (e.g., Agho, Price, & Mueller, 1992; Brooke, Russell, & Price, 1988). It is noteworthy that this construct was not assessed to directly address any formal hypotheses. Rather, it was included in the study to provide secondary evidence that perceived safety is associated with employee well-being. These items were responded to using a seven-point agreement scale ranging from 1 "Strongly disagree" to 7 "Strongly agree." Internal consistency for the responses to this measure in the present sample were satisfactory ($\alpha = .87$).

Life satisfaction. Life satisfaction was assessed using Diener, Emmons, Larsen, and Griffin's (1985) five-item measure. Like job satisfaction, this measure was included in the study to determine the extent to which perceived safety is associated with worker well-being indicators beyond just safety-related anxiety. These items were assessed using the same seven-point scale as job satisfaction and responses had favorable internal consistency (α = .86).

Psychological contract fulfillment. Psychological contract fulfillment with regard to workplace safety was assessed using four items derived from Robinson and Morrison's (2000) measure of perceived contract fulfillment. As with job and life satisfaction, this construct was assessed to provide additional evidence for perceived safety's association with other meaningful outcome variables and was not included to address any formal hypotheses. Responses to these items had a coefficient alpha of .83.

Analyses

This study's hypotheses were tested using both non-recursive and recursive structural equation modeling (SEM). SEM is appropriate in this context because the majority of this study's variables represent latent psychological constructs (Anderson & Gerbing, 1988; Bollen, 2002). Non-recursive models were estimated for analyses using only production employee responses whereas recursive models were used to test hypotheses that incorporated both employee and foreman responses (because these were separated in time). Non-recursive models are necessary when examining concurrent associations that are theorized to constitute negative feedback loops. This is because non-recursive models acknowledge the possibility of mutual causation (Kline, 2005). In this case, because perceived safety is theoretically expected to affect safety behavior through its influence on safety-related anxiety, and because safety behavior should in turn directly affect perceived safety, a non-recursive model was deemed most appropriate.

It is important to note that a key assumption for properly estimating a non-recursive model is that the hypothesized causal sequence has reached a state of equilibrium (Kaplan, Harik, & Hotchkiss, 2001; Kline, 2005). This means that the causal process under consideration should be at a steady state when a cross-sectional “snap-shot” of the process is taken (Kaplan et al., 2001; Kenny, 1979). This is a reasonable assumption for the current study because workers should already have perceived their safety level to be a function of the work context and past events (e.g., injuries) and their reported levels of safety-related anxiety and safety behavior should likewise have been a function of their perceived safety at the time of survey completion. In other words, the theorized causal process examined in this study was not expected to be so dynamic as to suppose it would be shifting during the time of survey completion.

In addition to the hypothesized paths specified in this model, there were a number of other parameters that were estimated based on theory and research to achieve more accurate model fit; non-hypothesized parameters are indicated by dashed lines in Figure 3. First, in accord with extant theory (Zohar, 2003) and meta-analytic research, which has revealed a meaningful negative relationship between past injuries and psychological safety climate (Beus et al., 2010), a path from knowledge of past injuries to psychological safety climate was specified in the proposed model. Second, a path from knowledge of injuries to perceived job risk was estimated given that prior injury knowledge is likely also to affect perceptions concerning the riskiness inherent to the job. Third, paths from safety locus of control and trait anxiety to perceived job risk were estimated due to the likelihood that these traits also influence workers’ appraisals of job

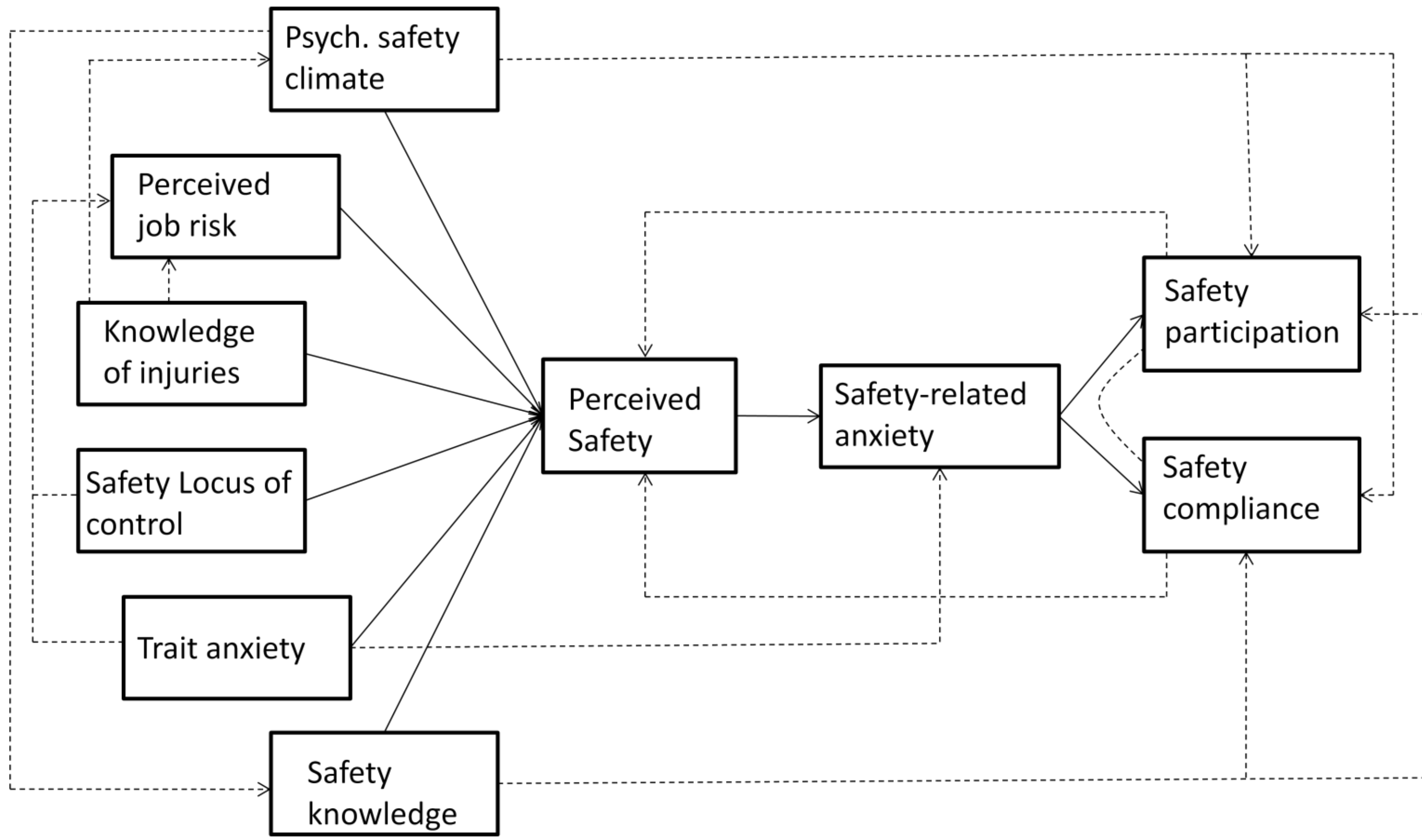

Figure 3. Summary of all estimated paths in single-source models. Hypothesized paths are represented by solid lines whereas non-hypothesized parameters are represented by dashed lines.

risk. Fourth, because safety climate is theoretically expected to affect safety behavior (Zohar, 2003) and has consistently demonstrated positive associations with safety performance (Christian et al., 2009; Clarke, 2006), paths from psychological safety climate to both safety compliance and safety participation were estimated. Fifth, because safety compliance and participation have demonstrated meaningful associations in past research (Christian et al., 2009; Neal & Griffin, 2006), these variables were freed to correlate with each other in the proposed model. Sixth, because trait anxiety should at least partially explain situational anxiety (Spielberger et al., 1970), a path from trait anxiety to safety-related anxiety was also specified in the model. Further, a path from safety climate to safety knowledge was estimated in light of previous meta-analytic evidence which has revealed a significant association between the constructs (Christian et al., 2009). Finally, given that safety knowledge has demonstrated meaningful associations with general safety behavior (Christian et al., 2009) and safety compliance and participation specifically (Griffin & Neal, 2000), paths from safety knowledge to safety compliance and safety participation were also estimated.

RESULTS

Preliminary Invariance Tests

Because data were collected from three distinct work sites, a preliminary step before combining responses across sites to test hypotheses was to determine that core constructs were perceived similarly by participants in each site. Consequently, a series of multi-group confirmatory factor analyses (CFAs) were conducted to test for metric invariance in selected core constructs: perceived safety, safety climate, safety compliance, and safety participation. Metric invariance (i.e., invariance of factor structures and item factor loadings) is considered the standard for determining that a construct is invariant across groups (Byrne, Shavelson, & Muthén, 1989; Muthén & Muthén, 2010). Failure to achieve metric invariance in these constructs would suggest that employees across the three sites perceived the constructs distinctly enough to preclude combining responses in an omnibus test of this study's hypotheses. Conversely, verification of metric invariance in these core constructs would provide evidence to suggest that combining responses across sites is appropriate.

Results of these selected invariance tests are reported in Table 3. As can be seen, although safety compliance ($\Delta\chi^2$ [6] = 5.47, *ns*) and safety participation ($\Delta\chi^2$ [6] = 10.68, *ns*) were metrically invariant across the three sites, perceived safety ($\Delta\chi^2$ [10] = 19.17, $p < .05$) and safety climate ($\Delta\chi^2$ [58] = 80.33, $p < .05$) were not. The failure of perceived safety, this study's core construct, to achieve metric invariance across the three sites offers sufficient evidence alone that it may not be appropriate to combine worker responses across sites for statistical tests. It is noteworthy, however, that perceived safety

Table 3

Multi-Group Invariance Tests Across Sites

Model	X^2	*df*	ΔX^2	Δdf	RMSEA	CFI	SRMR
Perceived Safety ($*X^2_{Crit}$ (10) = 18.31, $p < .05$)							
Configural Invariance	188.33	39			.14	.93	.14
Metric Invariance	207.50	49	19.17*	10	.13	.93	.17
Safety Climate ($*X^2_{Crit}$ (58) = 76.78, $p < .05$)							
Configural Invariance	2,922.45	1254			.08	.89	.07
Metric Invariance	3,002.78	1312	80.33*	58	.08	.89	.09
Safety Compliance ($*X^2_{Crit}$ (6) = 12.59, $p < .05$)							
Configural Invariance	34.38	14			.09	.99	.07
Metric Invariance	39.85	20	5.47	6	.07	.99	.09
Safety Participation ($*X^2_{Crit}$ (58) = 76.78, $p < .05$)							
Configural Invariance	82.87	14			.16	.94	.08
Metric Invariance	93.55	20	10.68	6	.14	.93	.11

Notes. These analyses were tested using full information maximum likelihood (FIML) estimation; *df* = degrees of freedom; ΔX^2 = the difference in X^2 to the next restricted model (e.g., configural tested against metric invariance); Δ *df* = change in df; RMSEA = root mean-square error approximation; CFI = comparative fit index; SRMR = standardized root mean square residual. [a]Analyses that meet the accepted standard for perceptual equivalence (Byrne, Shavelson, & Muthén, 1989).

was still represented well by a one-factor structure in each of the three sites (χ^2 [9] = 51.46, CFI = .94, RMSEA = .16[4], SRMR = .04, site 1; χ^2 [9] = 39.80, CFI = .96, RMSEA = .15, SRMR = .03, site 2; χ^2 [9] = 52.26, CFI = .95, RMSEA = .14, SRMR = .03, site 3). Its failure to achieve metric invariance simply suggests that the extent to which the latent construct explained variance in individual items differed by site. This

[4] RMSEA values are particularly prone to bias for models with few degrees of freedom such as this. Although it is reported here to be consistent with reporting convention, Kenny, Kaniskan, and McCoach (2011) argue that it is not informative to compute RMSEA for models with few degrees of freedom.

was likewise true of safety climate. Although it failed to demonstrate metric invariance, the construct was still represented sufficiently by a second-order factor structure with seven first-order factors in each individual site (χ^2 [398] = 919.79, CFI = .89, RMSEA = .08, SRMR = .06, site 1; χ^2 [398] = 919.14, CFI = .89, RMSEA = .09, SRMR = .06, site 2; χ^2 [398] = 864.96, CFI = .92, RMSEA = .07, SRMR = .06, site 3). This is consistent with evidence in past administrations which likewise supports a second-order factor structure for safety climate (cf. Beus et al., 2011).

In light of the preceding evidence, it was deemed most appropriate to test this study's hypotheses separately within each of the three participating sites as opposed to conducting one omnibus test of hypotheses that incorporated data from all three sites. This decision meant that each hypothesis was evaluated three times and subsequently offers the ability to cross-validate the proposed theoretical model.

Hypothesis Tests

Descriptive statistics and variable intercorrelations for all study variables are reported separately for each site in Tables 4 through 6 (corresponding to sites 1, 2, and 3, respectively). For completeness, descriptive statistics and variable intercorrelations for the combined sample are reported in Appendix C as well.

Perceived safety antecedents. Overall model results for each site are depicted in Figures 4 through 6 with standardized path coefficients listed for both hypothesized and non-hypothesized paths. Similarly, a model illustrating results for the full sample is provided in Appendix D. It is important to note that these models represent single-source associations only; Table 7 reports the results for Hypotheses 8a and 8b across the three

Table 4

Descriptive Statistics and Variable Inter-correlations for Site 1

Variable	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Psychological safety climate	3.64	0.62	(.88)								
2. Trait anxiety	2.55	0.68	-.09	(.83)							
3. Dutifulness	4.13	0.70	.29*	-.26*	(.93)						
4. Impression management	3.82	0.65	.22*	-.23*	.58*	(.56)					
5. Safety knowledge	4.34	0.55	.43*	-.30*	.46*	.33*	(.89)				
6. Job risk	2.76	1.08	.02	.17*	-.05	-.03	.12	(.87)			
7. Safety threshold	4.20	0.68	.33*	.06	.27*	.24*	.20*	.08	(.82)		
8. Internal locus of control	3.70	0.67	.10	.04	.16*	.10	.20*	.05	.22*	(.86)	
9. External locus of control	2.71	0.59	-.09	.31*	-.24*	-.23*	-.21*	.27*	.03	-.02	(.73)
10. Perceived safety	3.90	0.64	.36*	-.19*	.16*	.08	.27*	-.30*	.16*	.13	-.11
11. Safety anxiety [a]	1.65	0.56	-.13	.43*	-.04	-.07	-.16*	.31*	.06	.00	.28*
12. Job satisfaction [b]	5.06	1.12	.31*	-.25*	.30*	.30*	.26*	-.09	.26*	.17*	-.05
13. Life satisfaction [b]	4.88	1.17	.26*	-.27*	.28*	.19*	.15*	-.07	.16*	.12	-.01
14. Psychological contract fulfillment	3.92	0.67	.53*	-.11	.23*	.03	.26*	-.17*	.27*	.12	-.23*
15. Safety compliance	4.18	0.63	.38*	-.13	.37*	.23*	.56*	.04	.26*	.25*	-.20*
16. Safety participation	3.80	0.69	.47*	-.08	.28*	.19*	.52*	.24*	.35*	.28*	-.10
17. Knowledge of injuries	5.14	10.70	-.19*	.03	-.19*	-.07	-.04	.11	-.17*	-.08	.02
18. Experienced injuries	0.58	1.18	-.11	.09	-.16*	-.03	.01	.24*	-.11	-.20*	.05
19. Witnessed injuries	1.21	4.10	-.11	.00	-.13	-.01	-.03	.07	-.10	-.02	-.03
20. Learned injuries	3.42	7.32	-.20*	.03	-.17*	-.10	-.04	.09	-.17*	-.09	.04

Notes. These numbers are based on 190 employee responses in Site 1; Numbers in parentheses along the diagonal are coefficient alphas; $N = 23$ for correlations involving foreman-rated variables; [a] Items assessed using a 4-point scale; [b] Items assessed using a 7-point scale. * $p \leq .05$, two-tailed.

Table 4 continued…

Variable	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
21. Age	48.50	12.03	.03	.06	.09	.08	.13	.18*	.03	.12	.01
22. Job experience	23.20	12.04	.06	.01	.08	.09	.18*	.16*	.03	.13	-.10
23. Tenure	12.80	11.88	.01	.06	-.09	.07	.00	.19*	-.02	.02	.07
24. Hours worked per week	41.81	4.97	.02	-.09	.16*	.16*	.07	-.06	-.06	.04	-.04
Foremen-rated variables											
25. Opportunity to observe	3.87	0.92	.01	-.31	.38	.41	-.09	-.01	.43*	-.06	-.10
26. Safety knowledge	4.15	0.52	.01	-.26	.44*	.31	-.20	.00	.49*	-.01	.00
27. Safety compliance	4.20	0.60	.20	-.28	.50*	.36	-.26	-.07	.47*	-.16	.01
28. Safety participation	4.08	0.56	-.18	-.06	.31	.33	-.17	.09	.30	.21	.14

Notes. These numbers are based on 190 employee responses in Site 1; Numbers in parentheses along the diagonal are coefficient alphas; $N = 23$ for correlations involving foreman-rated variables. * $p \leq .05$, two-tailed.

Table 4 continued…

Variable	*M*	SD	10	11	12	13	14	15	16	17	18
10. Perceived safety	3.90	0.64	(.90)								
11. Safety anxiety [a]	1.65	0.56	-.37*	(.84)							
12. Job satisfaction [b]	5.06	1.12	.22*	-.30*	(.87)						
13. Life satisfaction [b]	4.88	1.17	.26*	-.34*	.62*	(.88)					
14. Psychological contract fulfillment	3.92	0.67	.53*	-.28*	.27*	.39*	(.84)				
15. Safety compliance	4.18	0.63	.35*	-.22*	.39*	.31*	.50*	(.92)			
16. Safety participation	3.80	0.69	.17*	-.03	.25*	.21*	.33*	.62*	(.86)		
17. Knowledge of injuries	5.14	10.70	-.14	.16*	-.16*	-.17*	-.18*	-.11	-.04	--	
18. Experienced injuries	0.58	1.18	-.20*	.29*	-.24*	-.29*	-.16*	-.15*	.01	.36*	--
19. Witnessed injuries	1.21	4.10	-.04	.04	-.06	-.05	-.15*	-.05	.02	.80*	.14
20. Learned injuries	3.42	7.32	-.14	.17*	-.16*	-.18*	-.15*	-.11	-.08	.94*	.29*
21. Age	48.50	12.03	-.01	.16*	.09	.04	.01	.23*	.27*	.14	.21*
22. Job experience	23.20	12.04	.02	.09	.09	-.01	.05	.23*	.24*	.23*	.25*
23. Tenure	12.80	11.88	-.07	.06	.03	-.03	-.09	.01	.09	.34*	.45*
24. Hours worked per week	41.81	4.97	.13	.06	.10	.04	.01	.05	-.04	.00	-.07
Foremen-rated variables											
25. Opportunity to observe	3.87	0.92	.33	.06	.16	.26	-.05	-.42*	-.08	.22	-.32
26. Safety knowledge	4.15	0.52	.48*	-.10	.18	.38	.08	-.24	.04	.33	-.18
27. Safety compliance	4.20	0.60	.46*	-.09	.17	.30	.05	-.37	.00	.24	-.40
28. Safety participation	4.08	0.56	.37	.04	-.09	.07	.04	-.37	-.32	.30	-.21

Notes. These numbers are based on 190 employee responses in Site 1; Numbers in parentheses along the diagonal are coefficient alphas; $N = 23$ for correlations involving foreman-rated variables; [a] Items assessed using a 4-point scale; [b] Items assessed using a 7-point scale. * $p \leq .05$, two-tailed.

Table 4 continued…

Variable	***M***	***SD***	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
19. Witnessed injuries	1.21	4.10	--									
20. Learned injuries	3.42	7.32	.58*	--								
21. Age	48.50	12.03	.11	.11	--							
22. Job experience	23.20	12.04	.17	.20*	.84*	--						
23. Tenure	12.80	11.88	.24*	.29*	.54*	.61*	--					
24. Hours worked per week	41.81	4.97	-.01	.00	-.03	.07	-.05	--				
Foremen-rated variables												
25. Opportunity to observe	3.87	0.92	.21	.23	-.25	-.11	-.07	.31	--			
26. Safety knowledge	4.15	0.52	.32	.29	-.15	-.13	-.01	.09	.71*	(.92)		
27. Safety compliance	4.20	0.60	.22	.29	-.21	-.23	-.20	.02	.79*	.87*	(.93)	
28. Safety participation	4.08	0.56	.35	.22	-.35	-.28	-.06	.18	.57*	.79*	.68*	(.89)

Notes. These numbers are based on 190 employee responses in Site 1; Numbers in parentheses along the diagonal are coefficient alphas; $N = 23$ for correlations involving foreman-rated variables. * $p \leq .05$, two-tailed.

Table 5

Descriptive Statistics and Variable Inter-correlations for Site 2

Variable	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Psychological safety climate	3.91	0.65	(.89)								
2. Trait anxiety	2.44	0.62	-.15*	(.80)							
3. Dutifulness	4.40	0.56	.34*	-.06	(.91)						
4. Impression management	3.97	0.65	.20*	-.12	.40*	(.66)					
5. Safety knowledge	4.18	0.44	.35*	-.10	.25*	.17*	(.65)				
6. Job risk	2.97	0.70	.09	.00	.06	.03	.34*	(.52)			
7. Safety threshold	4.26	0.71	.19*	.00	.41*	.22*	.25*	.14	(.86)		
8. Internal locus of control	3.88	0.61	.12	-.03	.28*	.24*	.19*	-.01	.31*	(.81)	
9. External locus of control	2.44	0.63	-.12	.33*	-.17*	-.15	.09	.14	-.15	-.15	(.76)
10. Perceived safety	4.19	0.61	.23*	-.16	.34*	.29*	.20*	-.29*	.39*	.37*	-.17*
11. Safety anxiety [a]	1.46	0.43	-.32*	.39*	-.18*	-.07	-.12	-.01	-.11	-.07	.33*
12. Job satisfaction [b]	5.30	1.04	.32*	-.29*	.32*	.23*	.09	-.04	.24*	.32*	-.34*
13. Life satisfaction [b]	5.10	1.08	.24*	-.35*	.16	.18*	-.01	-.12	.27*	.16	-.22*
14. Psychological contract fulfillment	4.34	0.66	.56*	-.06	.55*	.22*	.18*	-.10	.28*	.33*	-.24*
15. Safety compliance	4.43	0.58	.58*	-.12	.61*	.33*	.46*	.04	.40*	.32*	-.26*
16. Safety participation	4.13	0.66	.53*	-.16	.39*	.37*	.45*	.17*	.25*	.22*	-.15
17. Knowledge of injuries	0.72	1.46	-.04	.00	.00	-.06	.04	.11	-.01	.00	-.11
18. Experienced injuries	0.02	0.14	.06	-.05	.13	.03	.08	.01	.11	.11	.03
19. Witnessed injuries	0.10	0.45	.23	-.09	.16	.10	.02	-.10	.12	.06	-.24*
20. Learned injuries	0.62	1.29	-.11	.04	-.07	-.10	.04	.14	-.05	-.02	-.06

Notes. These numbers are based on 151 employee responses in Site 2; Numbers in parentheses along the diagonal are coefficient alphas; $N = 20$ for correlations involving foreman-rated variables; [a] Items assessed using a 4-point scale; [b] Items assessed using a 7-point scale. * $p \leq .05$, two-tailed.

Table 5 continued…

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
21. Age	35.99	11.25	-.04	.08	.12	.14	.03	.09	.05	.13	-.07
22. Job experience	8.40	9.42	.02	.18*	-.03	-.03	.15	.06	.12	.18*	.00
23. Tenure	3.76	4.59	-.16	.20*	-.15	-.08	.08	.04	.00	-.10	.05
24. Hours worked per week	41.49	5.76	.19	.05	-.02	-.14	.04	.11	-.10	.00	-.11
Foremen-rated variables	4.40	1.05	-.10	.26	.15	-.26	.13	.28	.15	-.08	.46*
25. Opportunity to observe	4.67	0.59	-.17	.24	.05	-.23	.11	.35	.05	-.06	.46*
26. Safety knowledge	4.63	0.59	-.18	.25	.06	-.31	.06	.40	.18	-.13	.49*
27. Safety compliance	4.38	0.72	-.16	.24	.12	-.14	.16	.57*	.17	.02	.46*

Notes. These numbers are based on 151 employee responses in Site 2; Numbers in parentheses along the diagonal are coefficient alphas; $N = 20$ for correlations involving foreman-rated variables. * $p \leq .05$, two-tailed.

Table 5 continued…

Variable	*M*	*SD*	10	11	12	13	14	15	16	17	18
10. Perceived safety	4.19	0.61	(.92)								
11. Safety anxiety [a]	1.46	0.43	-.30*	(.73)							
12. Job satisfaction [b]	5.30	1.04	.24*	-.21*	(.85)						
13. Life satisfaction [b]	5.10	1.08	.29*	-.31*	.51*	(.87)					
14. Psychological contract fulfillment	4.34	0.66	.50*	-.37*	.38*	.29*	(.80)				
15. Safety compliance	4.43	0.58	.47*	-.34*	.38*	.18*	.68*	(.93)			
16. Safety participation	4.13	0.66	.27*	-.31*	.30*	.20*	.45*	.71*	(.86)		
17. Knowledge of injuries	0.72	1.46	-.11	-.05	-.01	.10	-.09	.00	-.04	--	
18. Experienced injuries	0.02	0.14	.03	.03	.10	.04	.03	.15	.12	.30*	--
19. Witnessed injuries	0.10	0.45	.14	-.12	.15	.14	.18*	.19*	.07	.51*	.40*
20. Learned injuries	0.62	1.29	-.15	-.03	-.06	.07	-.15	-.07	-.06	.95*	.08
21. Age	35.99	11.25	-.07	.08	.13	-.02	.07	.08	.07	.17	.15
22. Job experience	8.40	9.42	-.05	.08	.13	-.06	.03	.07	.19*	.13	.13
23. Tenure	3.76	4.59	-.18*	.13	-.03	-.15	-.17*	-.12	-.01	.12	-.04
24. Hours worked per week	41.49	5.76	-.09	-.18*	-.02	-.01	.13	.12	.19*	.07	-.25*
Foremen-rated variables											
25. Opportunity to observe	4.40	1.05	-.24	.14	-.22	-.12	-.09	.10	.24	.10	.14
26. Safety knowledge	4.67	0.59	-.25	.13	-.27	-.24	-.14	.04	.14	.04	.07
27. Safety compliance	4.63	0.59	-.23	.07	-.20	-.16	-.11	.06	.20	-.08	-.05
28. Safety participation	4.38	0.72	-.18	-.02	-.16	-.24	-.05	.08	.27	-.23	-.21

Notes. These numbers are based on 151 employee responses in Site 2; Numbers in parentheses along the diagonal are coefficient alphas; $N = 20$ for correlations involving foreman-rated variables; [a] Items assessed using a 4-point scale; [b] Items assessed using a 7-point scale. * $p \leq .05$, two-tailed.

Table 5 continued…

Variable	*M*	*SD*	19	20	21	22	23	24	25	26	27	28
19. Witnessed injuries	0.10	0.45	--									
20. Learned injuries	0.62	1.29	.22*	--								
21. Age	35.99	11.25	.21*	.11	--							
22. Job experience	8.40	9.42	.15	.11	.68*	--						
23. Tenure	3.76	4.59	-.01	.13	.40*	.56*	--					
24. Hours worked per week	41.49	5.76	.00	.10	-.02	.14	.08	--				
Foremen-rated variables												
25. Opportunity to observe	4.40	1.05	.19	.05	.38	.38	.22	.22	--			
26. Safety knowledge	4.67	0.59	.12	-.01	.45*	.44	.31	.23	.92*	(.99)		
27. Safety compliance	4.63	0.59	.02	-.13	.42	.42	.34	.23	.92*	.96*	(.97)	
28. Safety participation	4.38	0.72	-.13	-.26	.24	.26	.28	.22	.78*	.87*	.92*	(.89)

Notes. These numbers are based on 151 employee responses in Site 2; Numbers in parentheses along the diagonal are coefficient alphas; $N = 20$ for correlations involving foreman-rated variables. * $p \leq .05$, two-tailed.

Table 6

Descriptive Statistics and Variable Inter-correlations for Site 3

Variable	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Psychological safety climate	3.88	0.56	(.86)								
2. Trait anxiety	2.46	0.64	-.29*	(.81)							
3. Dutifulness	4.28	0.64	.34*	-.21*	(.91)						
4. Impression management	3.83	0.67	.21*	-.22*	.49*	(.63)					
5. Safety knowledge	4.45	0.47	.49*	-.23*	.48*	.30*	(.88)				
6. Job risk	2.93	1.03	-.15*	.07	-.10	-.10	-.02	(.79)			
7. Safety threshold	4.31	0.67	.21*	-.08	.34*	.20*	.44*	.12	(.83)		
8. Internal locus of control	3.71	0.65	.15*	-.02	.29*	.12*	.24*	.01	.17*	(.84)	
9. External locus of control	2.57	0.59	-.13*	.34*	-.19*	-.13*	-.23*	.20*	-.02	-.08	(.68)
10. Perceived safety	3.88	0.68	.49*	-.29*	.25*	.13*	.35*	-.25*	.03	.24*	-.26*
11. Safety anxiety [a]	1.58	0.49	-.32*	.42*	-.17*	-.18*	-.23*	.27*	.01	-.04	.24*
12. Job satisfaction [b]	4.90	1.19	.35*	-.33*	.29*	.25*	.32*	-.15*	.26*	.16*	-.14*
13. Life satisfaction [b]	4.73	1.12	.31*	-.29*	.25*	.27*	.27*	-.14*	.11	.13*	-.18*
14. Psychological contract fulfillment	4.08	0.61	.52*	-.28*	.28*	.13*	.39*	-.23*	.06	.20*	-.31*
15. Safety compliance	4.40	0.54	.50*	-.22*	.54*	.30*	.63*	-.13*	.34*	.23*	-.19*
16. Safety participation	4.08	0.65	.35*	-.11	.30*	.16*	.41*	.01	.17*	.24*	-.16*
17. Knowledge of injuries	2.89	6.49	.03	-.14	.03	.07	.04	.23*	-.05	-.13	.08
18. Experienced injuries	0.35	1.50	.05	-.01	.02	.08	.03	.12	.01	-.13*	.17*
19. Witnessed injuries	0.51	1.46	.01	-.09	.07	.06	.00	.14*	-.03	-.12	.02
20. Learned injuries	2.07	4.45	.02	-.16*	.01	.05	.05	.19*	-.08	-.10	.05

Notes. These numbers are based on 254 employee responses in Site 3; Numbers in parentheses along the diagonal are coefficient alphas; $N = 32$ for correlations involving foreman-rated variables; [a] Items assessed using a 4-point scale; [b] Items assessed using a 7-point scale. * $p \leq .05$, two-tailed.

Table 6 continued…

Variable	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
21. Age	40.47	12.18	.04	.08	.13	.11	.11	.03	.26*	-.09	-.02
22. Job experience	12.10	10.95	-.01	.10	-.03	.03	-.05	-.05	.09	-.07	.02
23. Tenure	5.71	6.75	.09	.09	.05	.10	.08	.04	.12	-.04	.08
24. Hours worked per week	41.98	3.66	-.01	-.02	-.10	.03	-.06	-.02	-.08	-.03	-.07
Foremen-rated variables	4.22	0.66	.06	-.18	.05	-.14	.14	-.15	-.10	-.13	-.01
25. Opportunity to observe	4.41	0.54	-.05	-.07	-.28	-.26	-.06	-.07	-.27	-.15	-.32
26. Safety knowledge	4.52	0.47	.01	-.10	-.18	-.09	.09	-.02	-.30	-.02	-.51*
27. Safety compliance	4.10	0.64	-.09	-.04	-.19	-.26	-.16	-.13	-.19	-.23	-.27

Notes. These numbers are based on 254 employee responses in Site 3; Numbers in parentheses along the diagonal are coefficient alphas; $N = 32$ for correlations involving foreman-rated variables. * $p \leq .05$, two-tailed.

Table 6 continued…

Variable	*M*	*SD*	10	11	12	13	14	15	16	17	18
10. Perceived safety	3.88	0.68	(.89)								
11. Safety anxiety	1.58	0.49	-.35*	(.80)							
12. Job satisfaction	4.90	1.19	.36*	-.42*	(.89)						
13. Life satisfaction	4.73	1.12	.32*	-.43*	.58*	(.84)					
14. Psychological contract fulfillment	4.08	0.61	.59*	-.39*	.34*	.28*	(.81)				
15. Safety compliance	4.40	0.54	.42*	-.23*	.39*	.31*	.50*	(.90)			
16. Safety participation	4.08	0.65	.27*	-.04	.23*	.14*	.36*	.53*	(.85)		
17. Knowledge of injuries	2.89	6.49	-.10	.23*	-.20*	-.13	-.10	-.01	-.06	--	
18. Experienced injuries	0.35	1.50	-.07	.20*	-.09	-.01	-.09	-.02	-.04	.60*	--
19. Witnessed injuries	0.51	1.46	-.13	.25*	-.24*	-.23*	-.12	-.02	-.06	.86*	.38*
20. Learned injuries	2.07	4.45	-.07	.11	-.14*	-.08	-.05	.01	-.04	.96*	.39*
21. Age	40.47	12.18	-.02	.09	.19*	-.05	.03	.08	.15*	.00	.16*
22. Job experience	12.10	10.95	-.08	.12	.07	-.09	-.03	-.03	.09	.02	.18*
23. Tenure	5.71	6.75	.01	.13	.05	-.05	-.01	.06	.07	.04	.21*
24. Hours worked per week	41.98	3.66	.03	-.08	.10	.00	.07	-.10	.09	-.09	-.14*
Foremen-rated variables											
25. Opportunity to observe	4.22	0.66	.35*	-.13	-.10	-.44*	-.05	-.03	.15	.32	.33
26. Safety knowledge	4.41	0.54	.32	-.19	.07	-.24	.04	-.06	.27	.25	.31
27. Safety compliance	4.52	0.47	.35*	-.23	.11	.03	.20	.16	.22	.14	.26
28. Safety participation	4.10	0.64	.19	-.19	.08	-.21	.11	-.01	.18	.26	.31

Notes. These numbers are based on 254 employee responses in Site 3; Numbers in parentheses along the diagonal are coefficient alphas; $N = 32$ for correlations involving foreman-rated variables; [a] Items assessed using a 4-point scale; [b] Items assessed using a 7-point scale. * $p \leq .05$, two-tailed.

Table 6 continued…

Variable	*M*	*SD*	19	20	21	22	23	24	25	26	27	28
19. Witnessed injuries	0.51	1.46	--									
20. Learned injuries	2.07	4.45	.79*	--								
21. Age	40.47	12.18	-.02	-.05	--							
22. Job experience	12.10	10.95	.02	-.04	.63*	--						
23. Tenure	5.71	6.75	-.01	-.02	.47*	.57*	--					
24. Hours worked per week	41.98	3.66	-.12	-.04	.13	.15*	.08	--				
Foremen-rated variables												
25. Opportunity to observe	4.22	0.66	.20	.18	.02	-.07	.07	.28	--			
26. Safety knowledge	4.41	0.54	.09	.14	.05	.08	.09	.23	.71*	(.93)		
27. Safety compliance	4.52	0.47	-.05	.10	-.12	.02	-.10	.09	.41*	.67*	(.92)	
28. Safety participation	4.10	0.64	.10	.16	.11	-.06	.02	.23	.56*	.85*	.42*	(.85)

Notes. These numbers are based on 254 employee responses in Site 3; Numbers in parentheses along the diagonal are coefficient alphas; $N = 32$ for correlations involving foreman-rated variables. * $p \leq .05$, two-tailed.

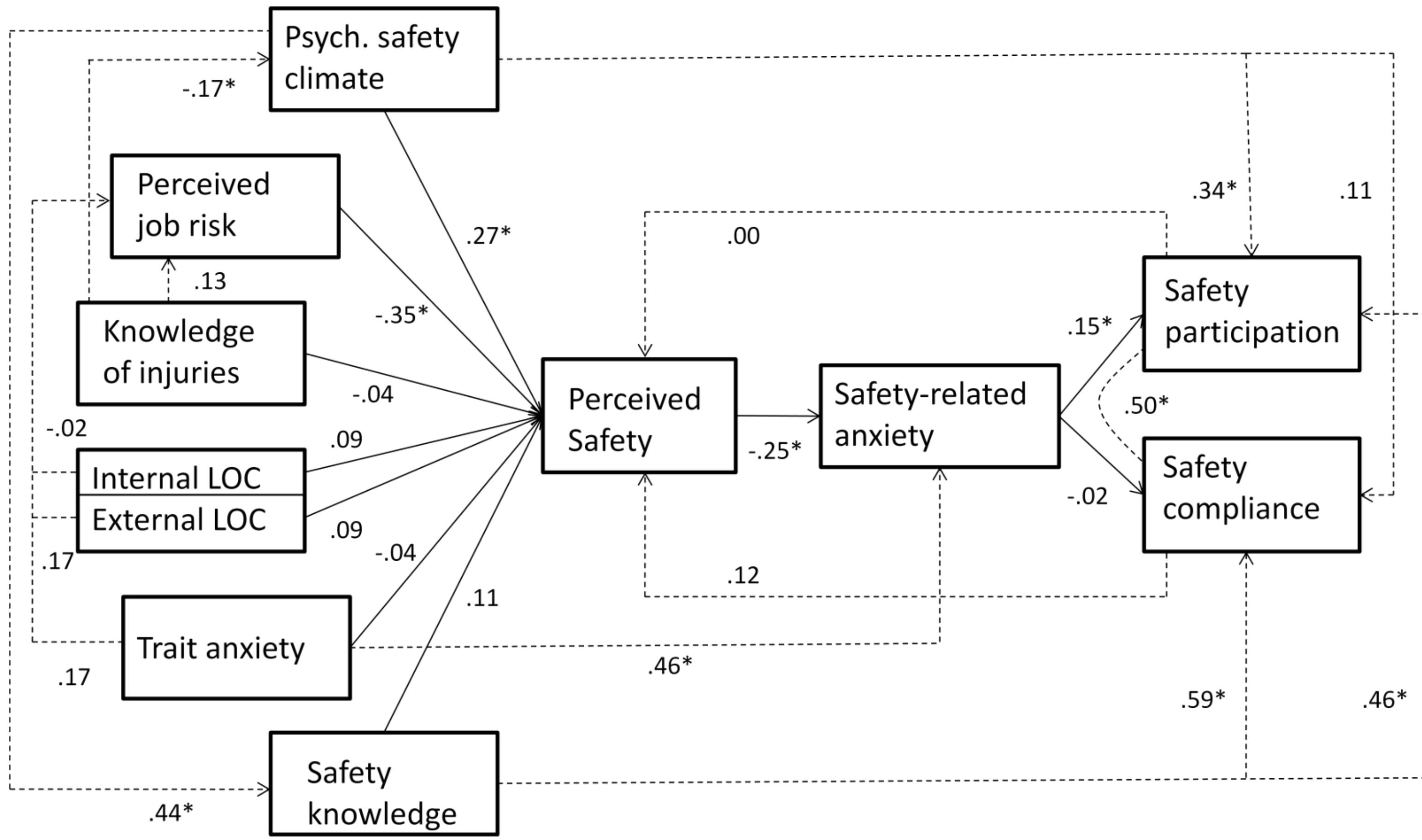

Figure 4. Single-source structural model results for site 1. Solid lines reflect hypothesized paths whereas dashed lines reflect non-hypothesized parameters; all estimates are standardized. $N = 168$; Psych. safety climate = Psychological safety climate; LOC = Locus of control. Results for model fit: $\chi^2(3{,}698) = 6{,}555.91$, CFI = .75, RMSEA = .07, SRMR = .10. $^*p \leq .05$.

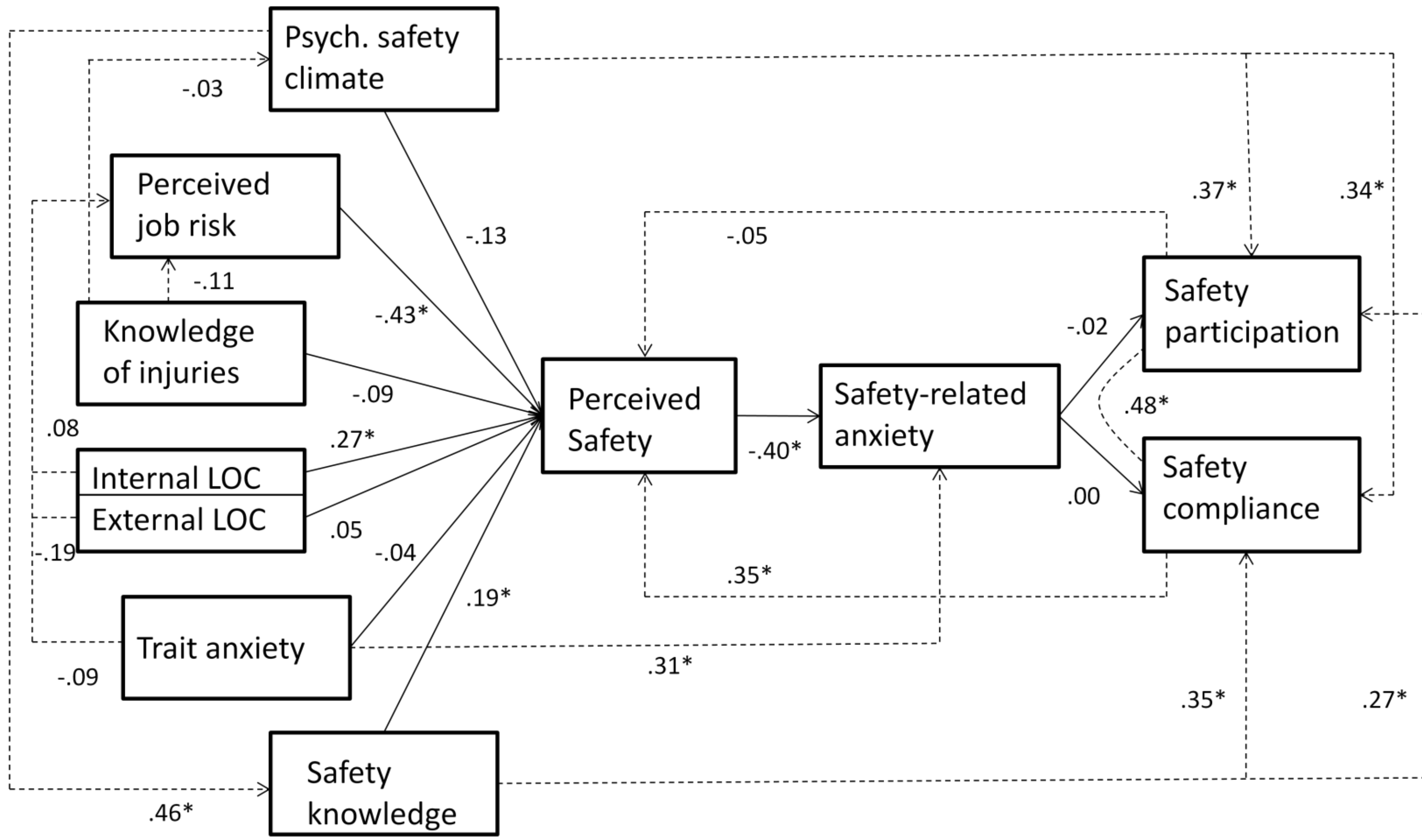

Figure 5. Single-source structural model results for site 2. Solid lines reflect hypothesized paths whereas dashed lines reflect non-hypothesized parameters; all estimates are standardized. N = 141; Psych. safety climate = Psychological safety climate; LOC = Locus of control. Results for model fit: $\chi^2(3{,}698) = 7{,}066.21$, CFI = .69, RMSEA = .08, SRMR = .13. $^*p \leq .05$.

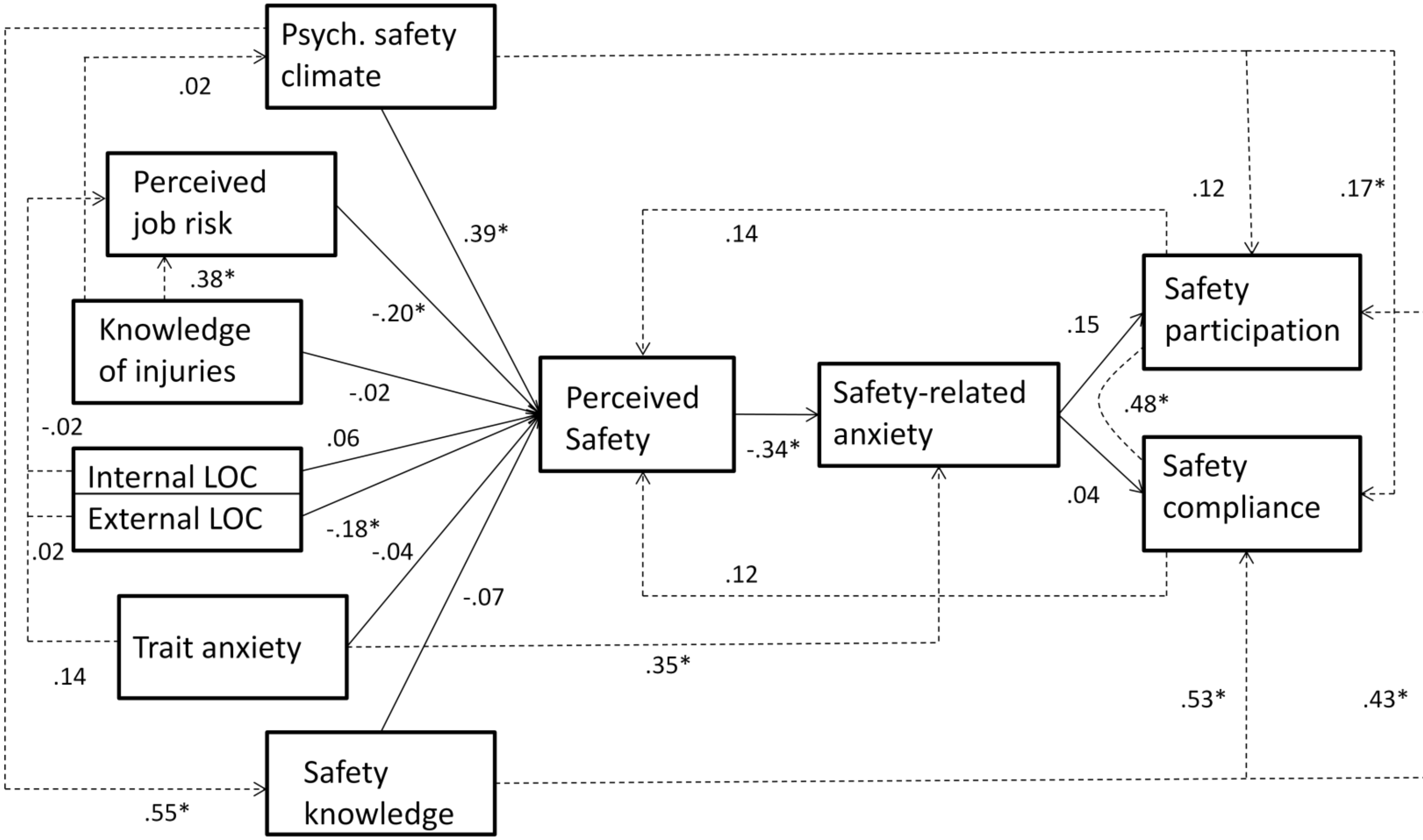

Figure 6. Single-source structural model results for site 3. Solid lines reflect hypothesized paths whereas dashed lines reflect non-hypothesized parameters; all estimates are standardized. N = 199; Psych. safety climate = Psychological safety climate; LOC = Locus of control. Results for model fit: $\chi^2(3{,}698) = 6{,}439.89$, CFI = .77, RMSEA = .06, SRMR = .12. $^*p \leq .05$.

sites which incorporate foreman-rated employee safety behaviors. For Hypothesis 1, in which the knowledge of injuries was posited to share a negative association with perceived safety, none of the associations in any site were statistically significant; all effects were negative but near-zero in magnitude ($\beta = -.04$, *ns*, site 1; $\beta = -.09$, *ns*, site 2; $\beta = -.02$, *ns,* site 3). Thus, Hypothesis 1 was not supported—knowledge of injury occurrences does not appear to have a meaningful association with perceived safety.

For Hypothesis 2, which posited a negative association between perceived job risk and perceived safety, all three analyses were consistent with expectations. Specifically, site 1 ($\beta = -.35$, $p < .05$), site 2 ($\beta = -.43$, $p < .05$), and site 3 ($\beta = -.20$, $p < .05$) revealed significant negative associations. Thus, Hypothesis 2 received full support, suggesting that greater perceived job risk is associated with reduced perceived safety.

Hypothesis 3, which posited a positive association between psychological safety climate and perceived safety, received mixed support. Sites 1 ($\beta = .27$, $p < .05$) and 3 ($\beta = .39$, $p < .05$) both revealed statistically significant positive associations. However, site 2 revealed an association in the opposite direction ($\beta = -.13$, *ns*) although it was not significant. Taken together, these findings provide partial support for Hypothesis 3.

Hypothesis 4 posited a negative association between trait anxiety and perceived safety. Although all associations were negative ($\beta = -.04$, *ns,* site 1; $\beta = -.04$, *ns*, site 2; $\beta = -.04$, *ns*, site 3), none were statistically meaningful. Thus, Hypothesis 4 was not supported. This suggests that trait anxiety does not have a meaningful association with perceived safety.

Hypothesis 5 conjectured that there is a positive association between safety locus of control and perceived safety. To test this hypothesis, perceived safety's associations with both safety internality and safety externality were assessed. Because higher levels of safety internality suggest greater safety locus of control, a positive association was expected with perceived safety. However, because higher levels of externality suggest lower safety locus of control, a negative association between safety externality and perceived safety was expected. For safety internality, only site 2 supported expectations; this site revealed a significant positive association ($\beta = .27$, $p < .05$) whereas sites 1 ($\beta = .09$, *ns*) and 3 ($\beta = .06$, *ns*) revealed near-zero associations. For safety externality, only site 3 supported expectations ($\beta = -.18$, $p < .05$); sites 1 ($\beta = .09$, *ns*) and 2 ($\beta = .05$, *ns*) both revealed positive, near-zero associations. Taken together, these results provide only limited support for Hypothesis 5 as only two out of six analyses supported expectations. Thus, it appears that safety locus of control generally does not share a meaningful association with perceived safety.

Hypothesis 6 conjectured a positive association between safety knowledge and perceived safety. Only one of three sites supported this hypothesis. Site 2 revealed a significant, positive association ($\beta = .19$, $p < .05$) whereas sites 1 ($\beta = .11$, *ns*) and 3 ($\beta = -.07$, *ns*) demonstrated non-significant relationships. Thus, Hypothesis 6 only received limited support.

Perceived safety outcomes. Hypothesis 7 posited a negative association between perceived safety and safety-related anxiety. Consistent with expectations, these variables revealed significant, negative associations in all three sites ($\beta = -.25$, $p < .05$, site 1; $\beta =$ -

.40, $p < .05$, site 2; β = -.34, $p < .05$, site 3). Consequently, Hypothesis 7 received full support, suggesting that feeling less safe results in higher levels of safety-related anxiety.

Based on a cybernetic framework, safety-related anxiety was expected to subsequently reveal positive associations with both safety compliance (Hypothesis 8a) and safety participation (Hypothesis 8b). Because safety behaviors were both employee-rated and foreman-rated, single-source and self-other results are reported here. Results of site-specific analyses using foreman-rated safety behaviors are reported in Table 7; analyses using foreman-rated safety behavior combined across all three sites are reported in Appendix E for completeness.

For Hypothesis 8a, none of the sites revealed statistically meaningful single-source associations between safety-related anxiety and safety compliance (β = -.02, *ns*, site 1; β = .00, *ns*, site 2; β = .04, *ns*, site 3). When assessing the relationship between employee-reported safety-related anxiety and foreman-reported safety compliance, two sites demonstrated positive, non-significant associations (β = .03, *ns*, site 1; β = .16, *ns*, site 2) and one site revealed a statistically significant, negative association (β = -.41, $p < .05$, site 3). Taken together, analyses using both employee-reported and foreman-reported safety behavior separately suggest that safety-related anxiety does not share a meaningful, positive association with employee safety compliance behaviors. Thus, Hypothesis 8a was not supported.

For Hypothesis 8b, which conjectured a positive relationship between safety-related anxiety and safety participation, single-source analyses partially supported expectations; specifically, site 1 revealed a significant, positive association (β = .15, $p <$

Table 7

Safety-Related Anxiety Predicting Foreman-Rated Employee Safety Behaviors

Variable[a]	Site 1 Comp.	Site 1 Part.	Site 2 Comp.	Site 2 Part.	Site 3 Comp.	Site 3 Part.
Psychological safety climate	.40	-.04	-.25	-.23	-.12	-.22
Safety knowledge	-.36	-.24	.24	.24	.08	-.23
Safety-related anxiety	.03	.19	.16	-.01	-.41*	-.46*

Notes. Comp. = Safety compliance; Part. = Safety participation; these analyses were tested using full information maximum likelihood estimation; site 1, N = 190 (dependent variables N = 22); site 2, N = 151 (dependent variables N = 19); site 3, N = 254 (dependent variables N = 29). All table entries represent standardized estimates. [a] Due to limited numbers of foreman ratings within sites, standard errors could not be corrected for non-independence to account for ratings nested within foremen. *$p \leq .05$.

.05). However, Sites 2 and 3 did not demonstrate statistically meaningful associations (β = -.02, *ns*, Site 2; β = .15, *ns*, Site 3), although it is noteworthy that Site 3 revealed an association of equal magnitude and direction relative to Site 1. When considering the association between employee-reported safety-related anxiety and foreman-reported safety participation, none of the sites supported expectations with two revealing non-significant associations (β = .19, *ns*, site 1; β = -.01, *ns*, site 2) and one revealing a statistically significant, negative association (β = -.46, p < .05, site 3). Taken together, although single-source analyses provided some support for Hypothesis 8b, both sets of analyses were generally unsupportive. These results suggest that safety-related anxiety does not share a consistently positive association with either employee- or foreman-reported safety participation behaviors.

Ancillary Analyses

Importance of feeling safe. As previously noted, one of the core assumptions of cybernetic theory applied to perceived safety is that individuals consider feeling safe to be important for optimal well-being and functioning at work. To gauge the extent to which participants believed this is true, safety threshold was assessed. Three safety threshold items were specifically designed to measure the degree to which employees considered feeling safe to be critical at work (with higher scores suggesting greater perceived importance). Mean responses for this construct across the three sites were 4.20 (*SD* = .68), 4.26 (*SD* = .71), and 4.31 (*SD* = .67), respectively (all items were rated on a five-point agreement scale ranging from 1 “strongly disagree” to 5 “strongly agree”). The magnitude of these means support the assumption that participants generally believed feeling safe is important at work.

Safety’s perceived importance may also influence the strength of the association between perceived safety and safety-related anxiety. Specifically, greater perceived importance for safety at work would be expected to correspond with a stronger relationship between perceived safety and safety-related anxiety; this is because a person who believes feeling safe is more critical would be expected to be more distressed when feeling unsafe than a person who believes feeling safe is less critical. However, perceived safety’s consistent, negative association with safety-related anxiety across all three sites suggests that workers were fairly uniform in considering safety to be important given that safety’s perceived absence was associated with greater anxiety. The magnitudes of safety threshold’s means across sites likewise suggest this.

Nevertheless, safety threshold was tested as a moderator of the relationship between perceived safety and safety-related anxiety in each site (in addition to main effects for perceived safety, safety threshold, and trait anxiety[5]). Results revealed no evidence of moderation (B = .16, *ns*, site 1; B = .00, *ns*, site 2; B = -.04, *ns*, site 3). This can possibly be attributed to restricted variance in safety threshold perceptions where responses may not have been variable enough to demonstrate a moderating effect. Ultimately, however, these combined results offer support for the core, underlying assumption of this study that individuals generally believe it is important to feel safe at work.

Impression management. A common concern with self-reported data is the potential for participants to engage in impression management tactics in an effort to display more socially desirable responses (Paulhus & Reid, 1991). To the extent that respondents engaged in such efforts, responses would be expected to be biased (Arthur & Glaze, 2011; Holden, 2008; Zerbe & Paulhus, 1987). Consequently, impression management items were administered to participants to gauge the extent to which they share meaningful associations with this study's core constructs with stronger associations suggesting the presence of greater bias.

Impression management's intercorrelations with all study variables by site are listed in Tables 4 through 6. As can be seen, impression management shared only small to moderate correlations with psychological safety climate (.22, .20, .21), perceived

[5] Perceived safety revealed significant, negative main effects (B = -.38, $p < .05$, site 1; B = -.43, $p < .05$, site 2; B = -.30, $p < .05$, site 3) and trait anxiety revealed significant, positive main effects (B = .26, $p < .05$, Site 1; B = .20, $p < .05$, Site 2; B = .22, $p < .05$, Site 3) on safety-related anxiety whereas safety threshold revealed non-significant main effects (B = .11, *ns*, site 1; B = -.04, *ns*, site 2; B = .02, *ns*, site 3) across all three sites. These estimates are all unstandardized.

safety (.08, .29, .13), safety-related anxiety (-.07, -.07, -.18), safety compliance (.23, .33, .30), and safety participation (.19, .37, .16) across the three sites, suggesting that the influence of impression management on participant responses was not extreme[6]. Further, as noted previously, the poor internal consistency reliabilities for these items across sites (α = .56, .66, .63) likewise suggest that participants did not consistently respond to impression management items in socially desirable ways. Although lower internal consistencies naturally attenuate correlations with other variables, all of the above correlations remained small to moderate in magnitude—in accordance with conventional effect size heuristics (Cohen, 1988)—after statistically correcting for unreliability. Taken together, these findings suggest that impression management was not a meaningful source of response bias in the present sample.

Exploratory Analyses

Safety-related anxiety and safety behaviors. The near-zero association between safety-related anxiety and safety behaviors may suggest a non-linear relationship between the two constructs. In this case, a curvilinear association is theoretically plausible; specifically, the relationship between safety-related anxiety and safety behavior may follow a quadratic form similar to the classic inverted U shape that has traditionally been posited to reflect the relationship between arousal (i.e., stress) and performance (e.g., Jex, 1998; Yerkes & Dodson, 1908).

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[6] Although it is not uncommon for researchers to attempt to partial out shared variance related to impression management (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), such a practice runs the risk of eliminating meaningful construct variance and is widely discouraged (Brannick, Chan, Conway, Lance, & Spector, 2010; Conway & Lance, 2010; Ellingson, Sackett, & Hough, 1999; Schmitt & Oswald, 2006). Consequently, this was not considered a viable course of action in the present study, especially given that impression management did not appear to be a serious source of bias.

In the case of perceived safety, particularly low levels of safety-related anxiety may fail to motivate the appropriate level of safety behavior because arousal is too low. In cybernetic terms, a safety discrepancy would not be detected which would fail to motivate corrective action (e.g., changes in safety behavior; Cummings & Cooper, 1979; Edwards, 1992). Conversely, more moderate levels of safety-related anxiety may be associated with increased safety behavior because of a greater perceived discrepancy between current and desired safety (i.e., higher arousal). However, consistent with the posited arousal-performance relationship, particularly high levels of safety-related anxiety may be associated with *lower* reported safety behaviors as workers may no longer feel it is within their power to alleviate the perceived discrepancy. A reduced feeling of control over one's safety at higher levels of arousal also suggests that safety locus of control may be a moderating factor. Consequently, as exploratory examinations of safety-related anxiety's relationships with safety behaviors (i.e., safety compliance and participation), two sets of analyses were run. First, polynomial multiple regression models with latent variables were estimated to test the form of safety-related anxiety's relationships with both safety compliance and safety participation in each of the three sites (resulting in six separate analyses). Second, safety internality and externality were tested as moderators of the most explanatory forms (linear or quadratic) of the relationships demonstrated between safety-related anxiety and safety behavior in the previous analyses.

Results of these analyses are reported in Table 8. With regard to the form of the relationship between safety-related anxiety and safety behavior, polynomial regression

Table 8

Testing the Form of the Relationships between Safety-Related Anxiety and Safety Behaviors

Variable	Site 1 Comp.	Site 1 Part.	Site 2 Comp.	Site 2 Part.	Site 3 Comp.	Site 3 Part.
Psychological safety climate	.08	.35*	.27*	.37*	.13*	.26*
Safety knowledge	.51*	.64*	.44*	.52*	.56*	.53*
Safety-related anxiety	-.08	.18	-.13	-.26	-.02	.07
Safety-related anxiety^2	.10	-.03	.14	.55*	.10	.15

Notes. Comp. = Safety compliance; Part. = Safety participation; Safety-related anxiety^2 = Squared term; site 1, N = 190; site 2, N = 151; site 3, N = 254. All table entries represent unstandardized estimates because standardized estimates could not be estimated when testing latent variable interactions. Standard errors of model parameter estimates may not be trustworthy for sites 1 and 2 due to small sample sizes. *$p \leq .05$.

results were generally unsupportive. Although one analysis revealed a statistically significant, positive quadratic term (B = .55, $p < .05$, participation, Site 2), the remaining five analyses failed to provide evidence of curvilinear associations. Interestingly, the significant positive quadratic term with safety participation in Site 2 suggests that at higher levels of safety-related anxiety, workers reported working *more* safely. This is contrary to the expectation that higher levels of safety-related anxiety would be associated with lower reported safety behavior. Given the general lack of support for a curvilinear association, safety internality and externality were tested as moderators to determine the extent to which they provide additional explanatory power concerning the relationships between safety-related anxiety and safety behavior.

To ensure that the most appropriate forms of safety-related anxiety's relationships with safety behaviors were tested, the higher order regression terms that were most explanatory (i.e., linear or quadratic) from the previous analyses were tested in each respective model. Specifically, linear relationships were tested for all relationships with the exception of site 2 where a quadratic relationship was tested for safety participation and safety-related anxiety. Results from these analyses are provided in Table 9. Findings revealed that neither safety internality nor safety externality were meaningful moderators of the linear or quadratic relationships. It is noteworthy, however, that safety internality revealed significant, positive main effects on safety behavior in two analyses (B = .23, $p < .05$, participation, site 1; B = .17, $p < .05$, compliance, site 2) and a nearly-significant main effect in one other (B = .11, $p < .10$, compliance, site 1). These findings support previous research which has found associations between safety locus of control and safety behavior (Christian et al., 2009) that suggest workers with higher safety locus of control tend to work more safely.

Attitudinal outcomes of perceived safety. Although perceived safety revealed consistent, negative associations with safety-related anxiety in support of theoretical expectations, relevant attitudinal outcomes beyond the explanatory bounds of cybernetic theory were included in survey administrations as well to provide additional evidence of perceived safety's implications for employee well-being. Specifically, constructs associated with workers' satisfaction with their organization (i.e., perceived psychological contract fulfillment concerning safety), job (i.e., job satisfaction), and life (i.e., life satisfaction) were included and tested as correlates of perceived safety with the

Table 9

Testing Safety Internality and Externality as Moderators of the Relationships between Safety-Related Anxiety and Safety Behaviors

	Site 1		Site 2		Site 3	
Variable	Comp.	Part.	Comp.	Part.	Comp.	Part.
Psychological safety climate	.08	.35*	.26*	.37*	.14*	.25*
Safety knowledge	.48*	.57*	.43*	.43*	.54*	.45*
Safety-related anxiety	-.06	.15	-.05	-.23	.01	.12
Safety-related anxiety^2				.57*		
Internality	.11	.23*	.17*	.03	.02	.18
Externality	-.04	.09	-.08	.13	-.07	-.20
Safety-related anxiety x Internality[a]	-.11	-.24	-.09		-.03	.17
Safety-related anxiety x Externality	-.05	-.39	.08		.19	.54
Safety-related anxiety^2 x Internality				.51		
Safety-related anxiety^2 x Externality				-.57		

Notes. Comp. = Safety compliance; Part. = Safety participation; Safety-related anxiety^2 = Squared term; site 1, *N* = 190; site 2, *N* = 151; site 3, *N* = 254. All table entries represent unstandardized estimates because standardized estimates could not be estimated when testing latent variable interactions. Standard errors of model parameter estimates may not be trustworthy for sites 1 and 2 due to small sample sizes.
[a] Safety-related anxiety x Internality (Externality) = An estimated interaction effect between these two variables. *p ≤ .05.

expectation that greater perceived safety would be associated with more favorable perceptions in all three areas. Results of these analyses are provided in Table 10. Relevant covariates of each of these attitudinal variables were included in the analyzed models. Specifically, trait anxiety and safety locus of control (i.e., safety internality and

Table 10

Testing Attitudinal Outcomes of Perceived Safety

	Site 1			Site 2			Site 3		
Variable	PCF	JS	LS	PCF	JS	LS	PCF	JS	LS
Psych. safety climate	.36*			.50*			.31*		
Job satisfaction	-.05		.62*	.10		.42*	.10		.64*
Life satisfaction	.27*	.65*		-.04	.40*		-.06	.56*	
Psych. contract fulfillment		.06	.18*		.22*	-.02		.13	-.05
Internality	.04	.10	-.02	.07	.14	-.08	.10	.02	.05
Externality	-.07	.02	.06	-.08	-.14	.01	-.13*	.08	-.02
Trait anxiety	.16*	-.09	-.11	.15*	-.18*	-.16	.01	-.14*	-.09
Job tenure	-.03	.01	-.01	-.07	.07	-.05	.01	.04	-.04
Perceived safety	.37*	-.03	.04	.40*	-.09	.25*	.49*	.16	.06

Notes. Psych. safety climate = Psychological safety climate; Psych. contract fulfillment = Psychological contract fulfillment; PCF = Psychological contract fulfillment; JS = Job satisfaction; LS = Life satisfaction. All table entries represent standardized estimates; site 1, *N* = 178; site 2, *N* = 141; site 3, *N* = 219. *p ≤ .05.

externality) were included as covariates in each model as these variables were expected to affect satisfaction ratings. Each model also included the other satisfaction variables as covariates as these variables are naturally expected to share meaningful variance with each other. Psychological safety climate was included as a covariate for psychological contract fulfillment because of its heavy emphasis on management commitment to safety which could affect perceptions concerning the organization’s psychological contract fulfillment regarding safety. Tenure was also included as a covariate as individuals who stay longer could be expected to have greater satisfaction in all three areas.

Results revealed that perceived safety was positively associated with psychological contract fulfillment in all three sites ($\beta = .37$, $p < .05$, site 1; $\beta = .40$, $p < .05$, $p < .05$, site 2; $\beta = .49$, $p < .05$, site 3). Conversely, perceived safety was only significantly associated with life satisfaction in one analysis ($\beta = .25$, $p < .05$, site 2) and demonstrated no statistically significant associations with job satisfaction. In sum, although there was little support for perceived safety sharing meaningful associations with job and life satisfaction, perceived safety was meaningfully associated with employee reports of their organization's psychological contract fulfillment concerning safety. The implications of these findings along with the findings associated with this study's formal hypotheses are delineated in the sections that follow.

DISCUSSION

People have a basic psychological need to feel that they are free from physical harm or danger (Higgins, 2000; Maslow, 1943; Pittman & Zeigler, 2007; Pyszczynski et al., 1997). Given that need fulfillment is a major antecedent of individual well-being and a consistent motivator of behavior (Deci & Ryan, 2000; Diefendorff & Chandler, 2011; Tay & Diener, 2011), an individual's appraisal of the extent to which the need for safety is fulfilled (i.e., perceived safety) in the context of work thus has important individual and organizational implications. Consequently, the purpose of this study was to introduce the construct of perceived safety and empirically examine its implications in the workplace. Using cybernetic theory as a guiding framework, this study specifically sought to examine meaningful antecedents of perceived safety to determine how this perception is formed and to test perceived safety's associations with both employee well-being and safety behaviors as theoretically relevant outcomes.

With regard to the antecedents of perceived safety, results revealed that perceived job risk and psychological safety climate were the most robust predictors. Both constructs revealed meaningful associations with perceived safety in all or a majority of the three examined work sites. Worker safety knowledge and safety locus of control were somewhat less robust as predictors and only revealed significant associations in a third of the analyses conducted. In addition, neither trait anxiety nor knowledge of workplace injuries shared any statistically significant associations with perceived safety, suggesting that these variables are not meaningful antecedents.

In accordance with expectations, analyses of theorized outcomes of perceived safety revealed that perceived safety and safety-related anxiety were consistently negatively related across all three sites. This supports the expectation under cybernetic theory that a perceived safety discrepancy is psychologically troubling and leads to greater safety-related anxiety. Contrary to theoretical expectations, however, safety-related anxiety did not share consistent, positive associations with self- or foreman-reported safety compliance and participation behaviors. Although safety-related anxiety shared a significant positive association with self-reported safety participation in one site and a positive, albeit non-significant, association of the same magnitude with safety participation in another site, there was no support for an association between safety-related anxiety and safety compliance across the three sites. Taken together, these findings suggest that although a perceived safety discrepancy (low perceived safety) appears to be anxiety-inducing, workers may not consistently adjust their safety behavior to alleviate the perceived discrepancy. The theoretical and practical implications of these findings in addition to exploratory findings are addressed next.

Theoretical Implications of Cybernetics and Safety

Although researchers have used cybernetic principles to explain a number of psychological and behavioral phenomena both inside and outside of the workplace (e.g., Carver & Scheier, 1982; Cummings & Cooper, 1979; Edwards, 1992), this study constitutes the first known attempt to use a cybernetic framework to describe the psychological appraisal of perceived safety. Using cybernetic theory as the theoretical foundation, a number of individual and contextual variables were posited to act as antecedents of workers' appraisals of perceived safety. Of these variables, results revealed that the examined contextual variables (i.e., psychological safety climate, perceived job risk) were more consistently efficacious in explaining variance in perceived safety than the individual difference variables (i.e., trait anxiety, safety locus of control, safety knowledge). This suggests that the social context and nature of the job itself have a greater influence on perceived safety than the individual differences that were expected to have an effect. Further, although knowledge of workplace injuries was not meaningfully associated with workers' perceived safety, the severity, recency, and attribution of those injuries could each affect the extent to which injury knowledge affects perceived safety. Testing such factors as moderators could reveal instances in which the knowledge of injuries may be more strongly associated with perceived safety than these results suggest.

Cybernetic theory also suggests that a perceived safety discrepancy (i.e., low perceived safety) is psychologically troubling. Whereas results firmly supported this proposition, it is noteworthy that safety behaviors—compliance in particular—did not consistently appear to represent corrective actions designed to alleviate safety-related anxiety as expected. The failure to support this proposition, however, does not mean cybernetic theory is deficient in describing individuals' responses to safety-related anxiety. There are two potential explanations for these findings which I elaborate on next.

First, to the extent that employees were already behaving safely—which high self- and foreman-rated mean safety behavior ratings suggest was the case—it would not necessarily be reasonable to expect that a change in safety behavior would alleviate safety-related anxiety. This is perhaps particularly true for safety compliance as there are likely fewer means of altering rule-following behaviors relative to more discretionary and non-prescribed safety participation behaviors. If behaviors are already in-line with known safety rules then there is little else with regard to compliance that a worker can adjust to relieve anxiety. Correspondingly, it is noteworthy that this study's results revealed more restricted variance in both employee- and foreman-rated safety compliance behaviors in comparison to safety participation behaviors across all three sites. This may explain why there was no support for an association between safety-related anxiety and safety compliance and why there was some support for a positive association between safety-related anxiety and safety participation. Workers naturally have greater capability of enhancing their discretionary safety behaviors when they experience greater safety anxiety relative to more prescribed, rule-following behaviors. Nevertheless, it is still noteworthy that safety-related anxiety and safety participation did not consistently share meaningful, positive associations.

A second explanation for not finding consistent, positive associations between safety-related anxiety and safety behavior is that workers may use different means of corrective action when faced with safety-related anxiety. In discussing the relevance of cybernetic theory to occupational stress, Edwards (1992) outlined a number of different types of coping strategies (i.e., corrective actions) that can be taken to respond to perceived discrepancies and enhance well-being: problem-focused coping, appraisal-focused coping, and emotion-focused coping. Changing safety behaviors to alleviate a safety discrepancy represents a problem-focused coping strategy (Edwards, 1992; Lazarus & Folkman, 1984). Such strategies involve direct attempts to change the situation that causes anxiety. However, as already discussed, participants generally did not report engaging in greater safety behaviors when feeling less safe. Consequently, alternative coping strategies may have been seen by workers as more effective means of alleviating safety-related anxiety.

Appraisal-focused coping strategies represent attempts to cognitively reduce the importance of a particular discrepancy (Edwards, 1992; Lazarus & Folkman, 1984). In the case of perceived safety, this would involve discounting the value of feeling safe (or conversely, the detriment of feeling unsafe). However, given the perceived importance of safety demonstrated in these data, and the fact that safety is widely considered to be a universal psychological need (Higgins, 2000; Maslow, 1943; Pittman & Zeigler, 2007; Pyszczynski et al., 1997), such a coping strategy seems unlikely. Alternative coping strategies that are perhaps more likely in response to safety-related anxiety are emotion-focused coping strategies (Edwards, 1992; Lazarus & Folkman, 1984). Such strategies represent direct attempts by individuals to improve well-being independent of the source of anxiety. Positive, emotion-focused strategies represent efforts to improve psychological and/or physical well-being and could include efforts such as relaxation and meditation (Newman & Beehr, 1979). Conversely, negative, emotion-focused strategies, which may temporarily help psychological well-being but damage physical well-being, could include behaviors such as increased alcohol consumption and smoking (Edwards, 1992). More research is needed to explore these coping strategies individually and in combination to determine which is the most frequent and effective response to safety-related anxiety and under what circumstances these coping strategies may change.

Can Feeling Safe Be Unsafe?

An additional and seemingly counterintuitive implication of cybernetic theory applied to perceived safety is that feeling safer is expected to lead to *reduced* safety behaviors. This is expected due to the mediating influence of safety-related anxiety. Feeling unsafe is posited to enhance safety-related anxiety which, theoretically, is posited to increase safety behaviors in a direct effort to relieve the anxiety. Although results generally did not support a positive association between safety-related anxiety and safety behavior (safety compliance in particular), there was some evidence that greater safety-related anxiety is associated with increased safety participation behaviors. The occupational health psychology literature provides indirect empirical support for this general proposition as well. Specifically, in a meta-analysis of the relationship between perceived risk and health behavior, Brewer et al. (2007) found that greater perceived risk of disease was associated with increased vaccination behavior. The direction of these results likewise suggests that given lower perceived risk (i.e., higher perceived safety) individuals are less likely to engage in preventative health behaviors. This lends some credence to the notion that feeling safe can actually be less safe.

Cybernetic theory offers further explanation for this phenomenon and posits that a specific need or end-state in equilibrium (i.e., where current and desired states correspond) will lie dormant and be subordinate to other needs or goals until an event cognitively triggers a discrepancy (Cummings & Cooper, 1979; Lord et al., 2010). Thus, in the absence of a perceived safety discrepancy an individual is expected to have less motivation to alter (i.e., improve) their safety behaviors (assuming they have the ability to do so). In fact, feeling that the need for safety is fully met could even lead to a *decrease* in safety behaviors to conserve personal resources given that safety would represent a less salient concern and would be expected to require less effort to maintain (Miller, 1965).

Such expectations (and subsequent behaviors) have the possibility of being exacerbated due to the reality that accidents and injuries are low base-rate events (Hulin & Rousseau, 1980; Jacobs, 1970) which often do not co-occur when safety rules are ignored or when blatantly unsafe acts are committed (Reason, 2000). The frequent absence of negative consequences associated with unsafe behaviors or safety omissions effectively reinforces the continued commission (or omission) of those behaviors, potentially leading to increased feelings of complacency or invulnerability (Perloff, 1983). Thus, over time it is possible that feeling safe could reduce safety behaviors even further to the extent that the reduction in safety behavior does not result in accident or injury.

This suggests that there is value in individuals feeling unsafe to a certain degree when working—or at least being reminded of the salience of certain job risks. This should be particularly true for individuals who work in more dangerous or risky circumstances in which the consequences of error are more severe. In much the same way that the perceived risk of illness motivates the pursuit of vaccination (Brewer et al., 2007), feeling less safe (i.e., more at risk) would be expected to enhance vigilance and rule-following and thus reduce errors and shortcuts as direct means of avoiding physical harm. Interestingly, although theory on arousal and performance would suggest that particularly high levels of anxiety should reduce performance (Jex, 1998; Yerkes & Dodson, 1908), the one instance in this study's analyses where a significant curvilinear association was revealed between safety-related anxiety and safety participation revealed that at higher levels of safety-related anxiety, safety participation increased even more dramatically. This provides further support for the implication that it is potentially safer for workers to feel unsafe to a certain degree.

Nevertheless, although these analyses revealed some support for reduced perceived safety and subsequent safety-related anxiety increasing safety participation, there are negative correlates of workplace anxiety or strain that would call into question the appropriateness of promoting its presence by causing workers to feel less safe. For example, in the present study, safety-related anxiety revealed moderate, negative associations with perceptions of psychological contract fulfillment, job satisfaction, and life satisfaction (see Tables 4-6). Further, a meta-analysis by Darr and Johns (2008) revealed that greater work strain was associated with increased psychological and physical illness and absenteeism. However, although the negative outcomes of feeling unsafe are noteworthy, the negative outcomes associated with workplace accidents and injuries are often more immediately damaging for both the individuals involved (e.g., hospitalization, permanent or long-term disability, loss of income) and the employing organization (e.g., equipment damage, reputational damage, workers compensation costs). Consequently, there is merit for organizations to do whatever is feasible to ensure that employees work as safely as possible. Any efforts to increase vigilance and safety behavior by causing employees to feel less safe should nevertheless be approached with care given the potentially negative outcomes of doing so. Possible means of promoting healthy levels of safety-related anxiety are discussed in the following section.

Practical Implications

The psychological literature on fear arousal offers some idea as to how an organization could promote the appropriate levels of safety anxiety sufficient to encourage workers to engage in necessary safety behaviors. According to fear arousal theory, fear—a perceived threat to values or needs—induces arousal or anxiety (Chu, 1966). The probability that an individual takes action to reduce this anxiety is considered to be a positive function of three primary cognitions: the perceived magnitude or severity of the potential loss/event, the likelihood of the potential loss/event, and the perceived efficacy of preventing the potential loss/event (Chu, 1966; Rogers, 1983). An organization could thus be effective in motivating specific safety behaviors to the extent it is able to affect safety-related anxiety through these three cognitions.

For example, in the chemical processing industry, lockout-tagout procedures represent important safe-guards that can prevent dangerous events from occurring when conducting routine or scheduled maintenance on machines. According to fear arousal research, an organization seeking to improve adherence to these procedures could improve compliance by informing workers of (1) the severity of outcomes associated with failing to follow lockout-tagout procedures (e.g., personal injury, chemical release, equipment damage), (2) the likelihood of such outcomes occurring if procedures are not followed, and (3) the efficacy of the recommended solution (i.e., following lockout-tagout procedures) in preventing the associated outcomes. Past research has shown that of these three cognitions, perceived efficacy in taking a recommended course of action is particularly effective in motivating corrective action (Chu, 1966; Rogers & Mewborn, 1976). Thus, although it is beneficial to reiterate to workers the severity and likelihood of negative outcomes given the presence or absence of certain behaviors, it is perhaps more important to emphasize to workers that it is within their capabilities to take action to prevent these negative outcomes from occurring. Such a feeling of efficacy could counteract anxiety to a certain degree while also facilitating the desired safety behaviors.

There are other practical implications of this study's findings as well. For one, it is noteworthy that one of the factors that was most influential in informing workers' perceived safety was psychological safety climate. Whereas perceived job risk was also a meaningful antecedent, organizations have greater power to affect changes in safety climate than they generally do with regard to job risk. For example, although coal miners cannot help the fact that traveling down narrow mine shafts and working underground is part of their job description, it is still possible for a mining crew to foster a favorable safety climate despite the risks inherent to their job. Thus, organizations can improve perceived safety and stem unnecessary safety-related anxiety by working to demonstrate that safety has a greater organizational priority. One of the key means of doing so is to ensure that the appropriate behaviors are reinforced and supported. This could include praising safe working procedures and rewarding safety even when under time constraints. Such actions communicate to employees that safety truly has precedence over other organizational priorities (Zohar, 2008). The added value of improving safety climate is underscored by this study's non-hypothesized finding that psychological safety climate shared direct, positive associations with self-reported safety compliance and participation. This is consistent with safety climate theory and research which emphasize its importance as a predictor of worker safety behaviors (Christian et al., 2009; Zohar, 2003).

Exploratory analyses also revealed that internal safety locus of control revealed a number of meaningful, positive associations with safety behavior. Such a finding—that greater perceived control over workplace safety is associated with increased safety behaviors—is consistent with past findings regarding generalized locus of control (e.g., Christian et al., 2009). This has potential implications for personnel selection such that it may be advantageous for organizations to consider applicants' levels of internal safety locus of control as a predictor of future safety behaviors.

Limitations and Future Directions

There are some limitations of the present study that should be noted. First, the majority of this study's variables were assessed solely via self-reports, with the exception of worker safety knowledge and safety behavior (i.e., compliance and participation) which were assessed by both employees and foremen. However, self-reports necessarily constituted the primary source of data because of this study's focus on worker perceptions. Such a decision was justified because there is no more accurate or reasonable means to assess constructs such as perceived safety or safety-related anxiety than through workers' self-reports.

An additional limitation is that the majority of this study's variables were assessed concurrently (the exception being the foreman-rated variables). However, although the issues associated with cross-sectional designs are noteworthy (e.g., concerns regarding temporal precedence/reverse-causation; Shadish, Cook, & Campbell, 2002; Stone-Romero, 2011), there were not cogent theoretical reasons to separate the measurement of this study's variables in time for this initial examination. Although associations were posited to exist along a number of causal pathways (e.g., knowledge of injuries→perceived safety) that naturally presuppose temporal precedence, these causal processes should already have been underway at the time of their measurement. That is, workers should already have perceived their safety level to be a function of the work context (e.g., injuries, perceived job risk) and the subsequent causal process relating perceived safety to safety-related anxiety and safety behavior was expected to be in a state of equilibrium at the time the variables were assessed. Further, it was important first to establish that the posited associations existed concurrently before examining how such relations unfold over time (Shadish et al., 2002; Spector, 2002).

In light of this, given this study's findings demonstrating concurrent associations between perceived safety and theoretically-relevant antecedents and outcomes, the important next step is to consider the temporal dynamism of these constructs—with a particular focus on perceived safety. A useful means of exploring the dynamism of perceived safety and its interrelations with other variables is to use the experience sampling method in which construct measurement occurs at numerous points over a particular period of time (Csikszentmihalyi & Larson, 1987). Such a method could be used to determine the extent to which perceived safety varies within months, weeks, or even days. This represents an important issue for future research to consider.

The combination of the preceding two limitations (i.e., the use of concurrent, self-reported data) likewise raises concerns regarding common method bias (Conway & Lance, 2010; Spector, 2006)—specifically, that relationships between self-reported variables will be spuriously high due to shared method-related variance (cf. Campbell, 1982; Podsakoff et al., 2003). However, a recent examination of the effects of common method variance across multiple studies revealed that although there was evidence of minor inflation in observed relationships, this effect was almost fully counteracted by attenuation due to measurement error (Lance, Dawson, Birkelbach, & Hoffman, 2010). This evidence suggests that common method variance, offset by measurement unreliability, does not alter true score correlations as has commonly been supposed. Nevertheless, Conway and Lance (2010) noted that researchers should still proactively attempt to minimize the possibility for method-related bias, particularly with self-reported survey data.

Accordingly, there were a number of steps outlined by Podsakoff et al. (2003) that were taken to reduce the plausibility of method-related response biases in the present study. First, scale endpoints and formats for predictor and criterion variables were varied to avoid item anchoring effects. For example, a five-point agreement scale was used for perceived safety whereas a four-point agreement scale with different anchors was used for safety-related anxiety; these constructs were visually separated into distinct tables and incorporated different response instructions to further disrupt item anchoring effects. Second, item complexity and ambiguity were reduced as much as possible to alleviate reliance on individual heuristics or guessing. This was accomplished by using previously-administered and validated items where feasible and by having organizational representatives carefully review items for readability and relevance to the targeted sample. Third, participants were assured of the confidentiality of their responses both verbally and in writing and were explicitly encouraging to provide honest responses. Finally, impression management items were administered and correlated with study variables to gauge the extent to which respondents appeared to engage in socially desirable response patterns. As previously noted, small to moderate correlations between impression management and this study's core constructs suggest that this was not the case. Thus, in conjunction with the previously-cited research (i.e., Lance et al., 2010) which provides evidence to suggest that the effects of common method bias may not be as extreme as generally supposed, the combination of the above efforts mitigates the concern of common method bias even further in the present sample.

Although this study makes a number of important contributions to the extant occupational safety literature, future research is needed to add greater understanding in a number of areas. For one, the sample used in this study (i.e., production/manufacturing workers) was relatively narrow. Additional research is needed to expand these hypotheses to other working contexts. Considering individuals who work in more hazardous or unpredictable environments is particularly important. For example, perceived safety (and conversely, perceived risk) has important implications for law enforcement personnel as it could affect decision-making in life-or-death situations. A police officer who is either too complacent or too anxious may be more prone to costly mistakes. Similarly, considering the implications of perceived safety (or a lack thereof) for military personnel and civilian contractors who work in war zones or hostile environments would be particularly applicable as the consequences for inappropriately handled safety matters in such situations can be extreme.

It was noted previously that future research should consider the use of emotion-focused coping strategies in response to safety-related anxiety. In addition, although safety-related anxiety was not consistently associated with safety behaviors in the present study, it may be beneficial to consider safety behavior in different ways. Given that variance in safety compliance in particular is generally expected to be restricted to some degree, greater emphasis should be placed on more discretionary or participative safety behaviors. It is possible that the safety participation measure used in this study was too generalized to capture the range of behaviors workers engage in as a response to safety-related anxiety. Using a more detailed measure of safety participation, or citizenship, such as the multi-faceted measure developed by Hofmann, Morgeson, and Gerras (2003) may help to address this issue. Further, it may be beneficial to tailor safety behavior measures to be specifically applicable to the examined context. Qualitative methods such as interviews with subject matter experts could be used to create such context-specific measures of safety behavior. Such additional research efforts are needed to determine more confidently the extent to which safety-related anxiety affects (or fails to affect) safety behavior.

Finally, this study's findings also suggest the need for future research to investigate more proximal potential outcomes of safety-related anxiety. For example, a possible mediating mechanism between safety-related anxiety and safety behavior is safety vigilance. Vigilance constitutes enhanced awareness and a readiness to respond (Meyer & Lavin, 2005; Scott, Rogers, Hwang, & Zhang, 2006) that should be heightened with lower perceived safety and enhanced safety-related anxiety. Safety vigilance may represent a more consistently efficacious problem-focused coping strategy given that altering safety behaviors may not always be required or feasible when increased safety-related anxiety is experienced; that is, increased safety vigilance may be sufficient in alleviating perceived safety discrepancies. In summary, more research is clearly needed to determine more concretely how individuals respond when perceived safety discrepancies trigger safety-related anxiety.

CONCLUSION

This study provides a number of important contributions to the extant occupational safety literature. First, the construct of perceived safety and its role as an appraisal of need fulfillment was introduced; the lack of consideration for this construct in the psychological literature was a glaring omission in the needed effort to understand the psychology of safety at work. Further, using cybernetic theory as a guiding framework, this study identified specific factors (psychological safety climate, perceived job risk) that act as inputs to perceived safety and also demonstrated perceived safety's meaningful, negative association with safety-related anxiety. Although increased safety-related anxiety did not appear to consistently trigger changes in safety behavior as was expected under cybernetic theory, recommendations for future research were given to guide future efforts to determine why this was the case. Ultimately, the theory and findings of this study underscore the need for safety researchers to consider the construct of perceived safety and its implications for both individual and workplace safety.

REFERENCES

Agho, A. O., Price, J. L., & Mueller, C. W. (1992). Discriminant validity of measures of job satisfaction, positive affectivity and negative affectivity. *Journal of Occupational and Organizational Psychology, 65*, 185-196.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*, 411-423.

Arthur, W. Jr., & Glaze, R. M. (2011). Cheating and response distortion on remotely delivered assessments. In N. T. Tippins & S. Adler (Eds.), *Technology-enhanced assessment of talent* (pp. 99-152). San Francisco: Jossey-Bass.

Barling, J., & Frone, M. R. (2003). *The psychology of workplace safety*. Washington DC: American Psychological Association.

Beus, J. M., Payne, S. C., & Arthur, W. Jr. (2011, April). *The initial validation of a universal measure of safety climate*. Paper presented at the 26th annual meeting of the Society for Industrial and Organizational Psychology, Chicago, IL.

Beus, J. M., Payne, S. C., Bergman, M. E., & Arthur, W. Jr. (2010). Safety climate and injuries: An examination of theoretical and empirical relationships. *Journal of Applied Psychology, 95*, 713-727.

Bollen, K. A. (2002). Latent variables in psychology and the social sciences. *Annual Review of Psychology, 53*, 605-634.

Borman, W.C., & Motowidlo, S.J. (1993). Expanding the criterion domain to include elements of contextual performance. In N. Schmitt & W.C. Borman (Eds.), *Personnel selection in organizations* (pp. 71-98). San Francisco: Jossey-Bass.

Brannick, M. T., Chan, D., Conway, J. M., Lance, C. E., & Spector, P. E. (2010). What is method variance and how can we cope with it? A panel discussion. *Organizational Research Methods, 13*, 407-420.

Brayfield, A. H., & Rothe, H. F. (1951). An index of job satisfaction. *Journal of Applied Psychology, 35*, 307-311.

Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology*, *26*, 136-145.

Brooke, P. P., Jr., Russell, D., & Price, J. L. (1988). Discriminant validation of measures of job satisfaction, job involvement, and organizational commitment. *Journal of Applied Psychology*, *73*, 139-145.

Bruk-Lee, V., Khoury, H. A., Nixon, A. E., Goh, A., & Spector, P. E. (2009). Replicating and extending past personality/job satisfaction meta-analyses. *Human Performance*, *22*, 156-189.

Bureau of Labor Statistics (2011). *Workplace injuries and illnesses in 2010*. Retrieved January 16, 2012 from http://bls.gov/iif/.

Burke, M. J., Salvador, R. O., Smith-Crowe, K., Chan-Serafin, S., Smith, A., & Sonesh, S. (2011). The dread factor: How hazards and safety training influence learning and performance. *Journal of Applied Psychology, 96*, 46-70.

Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin, 105,* 456-466.

Campbell, J. P. (1982). Editorial: Some remarks from the matrix. *Journal of Applied Psychology, 67,* 691-700.

Campbell, J. P., McCloy, R. A., Oppler, S. H., & Sager, C. E. (1993). A theory of performance. In N. Schmitt, W. C., Borman, & Associates (Eds.), *Personnel selection in organizations* (pp. 35-70). San Francisco: Jossey-Bass.

Carver, C. S., & Scheier, M. F. (1982). Control theory: A useful conceptual framework for personality-social, clinical, and health psychology. *Psychological Bulletin, 92*, 111-135.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York, NY: Cambridge University Press.

Chen, G., Goddard, T. G., & Casper, W. J. (2004). Examination of the relationships among general and work-specific self-evaluations, work-related control beliefs, and job attitudes. *Applied Psychology: An International Review, 53,* 349-370.

Christian, M. S., Bradley, J. C., Wallace, J. C., & Burke, M. J. (2009). Workplace safety: A meta-analysis of the roles of person and situation factors. *Journal of Applied Psychology, 94,* 1103-1127.

Chu, G. C. (1966). Fear arousal, efficacy, and imminency. *Journal of Personality and Social Psychology, 4*, 517-524.

Cigularov, K. P., Chen, P. Y., & Stallones, L. (2009). Error communication in young farm workers: Its relationship to safety climate and locus of control. *Work & Stress, 23*, 297-312.

Clarke, S. (2006). The relationship between safety climate and safety performance: A meta-analytic review. *Journal of Occupational Health Psychology, 11,* 315-327.

Clarke, S., & Robertson, I. T. (2005). A meta-analytic review of the Big Five personality factors and accident involvement in occupational and non-occupational settings. *Journal of Occupational and Organizational Psychology, 78,* 355-376.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.

Conway, J. M., & Lance, C. E. (2010). What reviewers should expect from authors regarding common method bias in organizational research. *Journal of Business and Psychology, 25*, 325-334.

Costa, P. T. Jr., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessments Resources.

Csikszentmihalyi, M., & Larson, R. (1987). Validity and reliability of the experience-sampling method. *The Journal of Nervous and Mental Disease, 175*, 526-536.

Cummings, T. G., & Cooper, C. L. (1979). A cybernetic framework for studying occupational stress. *Human Relations, 32,* 395-418.

Darr, W., & Johns, G. (2008). Work strain, health, and absenteeism: A meta-analysis. *Journal of Occupational Health Psychology, 13*, 293-318.

Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268.

Dictionary.com. (2010). *Safety*. Retrieved February 7, 2011 from http://dictionary.reference.com/browse/safety.

Diefendorff, J. M., & Chandler, M. M. (2011). Motivating employees. In S. Zedeck (Ed.), *APA handbook of industrial and organizational psychology* (Vol. 3, pp. 65-135). Washington, DC: American Psychological Association.

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*, 71-75.

Edwards, J. R. (1992). A cybernetic theory of stress, coping, and well-being in organizations. *Academy of Management Review*, *17*, 238-274.

Ellingson, J. E., Sackett, P. R., & Hough, L. M. (1999). Social desirability corrections in personality measurement: Issues of applicant comparison and construct validity. *Journal of Applied Psychology, 84*, 155-156.

Fiske, S. T., & Taylor, S. E. (1991). *Social cognition* (2nd ed.). New York, NY: McGraw Hill.

Gallagher, D. J. (1990). Extraversion, neuroticism, and appraisal of stressful academic events. *Personality and Individual Differences, 11*, 1053-1057.

Geller, E. S. (2001). *The psychology of safety handbook*. Boca Raton, FL: Lewis Publishers.

Gigerenzer, G., & Goldstein, D. G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review, 103*, 650-669.

Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psychological Assessment, 4*, 26-42.

Griffin, M.A., & Neal, A. (2000). Perceptions of safety at work: A framework for linking safety climate to safety performance. *Journal of Occupational Health Psychology, 5*, 347-358.

Henning, J. B., Stufft, C. J., Payne, S. C., Bergman, M. E., Mannan, M. S., & Keren, N. (2009). The influence of individual differences on organizational safety attitudes. *Safety Science, 47*, 337-345.

Higgins, E. T. (1997). Beyond pleasure and pain. *American Psychologist, 52*, 1280-1300.

Higgins, T. (1998). Promotion and prevention: Regulatory focus as a motivational principle. *Advances in Experimental Social Psychology, 30*, 1-46.

Higgins, E. T. (2000). Making a good decision: Value from fit. *American Psychologist, 55*, 1217-1230.

Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: Safety climate as an exemplar. *Journal of Applied Psychology, 88*, 170-178.

Holden, R. R. (2008). Underestimating the effects of faking on the validity of self-report personality scales. *Personality and Individual Differences, 44*, 311-321.

Holroyd, C. B., & Coles, M. G. H. (2002). The neural basis of human error processing: Reinforcement learning, dopamine, and the error-related negativity. *Psychological Review, 109*, 679-709.

Hulin, C. L., & Rousseau, D. M. (1980). Analyzing infrequent events: Once you find them, your troubles begin. In K. H. Roberts & L. Burstein (Eds.), *Issues in aggregation: New directions for methodology and behavioral science* (Vol. 6, p. 65-75). San Francisco: Jossey-Bass.

International Personality Item Pool. (2011). *The items in each of the preliminary IPIP scales measuring constructs similar to those in the NEO-PI-R*. Retrieved March 10, 2011 from http://ipip.ori.org/newNEOKey.htm#Anxiety.

Jacobs, H. H. (1970). Towards more effective safety measurement. *Journal of Safety Research, 2*, 160-175.

James, L. R., & Singh, B. K. (1978). An introduction to the logic, assumptions, and basic analytic procedures of two-stage least squares. *Psychological Bulletin*, *85*, 1104-1122.

Jermier, J. M., Gaines, J., & McIntosh, N. J. (1989). Reactions to physically dangerous work: A conceptual and empirical analysis. *Journal of Organizational Behavior, 10*, 15-33.

Jex, S. M. (1998). *Stress and job performance*. Thousand Oaks, CA: Sage Publications.

Johnson, E. J., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology, 45*, 20-31.

Jones, J. W., & Wuebker, L. J. (1985). Development and validation of the Safety Locus of Control Scale. *Perceptual and Motor Skills, 61*, 151-161.

Jones, J. W., & Wuebker, L. J. (1993). Safety locus of control and employees' accidents. *Journal of Business and Psychology, 7*, 449-457.

Judge, T. A., & Bono, J. E. (2001). Relationship of core self-evaluations traits—self-esteem, generalized self-efficacy, locus of control, and emotional stability—with job satisfaction and job performance: A meta-analysis. *Journal of Applied Psychology, 86*, 80-92.

Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under uncertainty: Heuristics and biases*. New York, NY: Cambridge University Press.

Kaplan, D., Harik, P., & Hotchkiss, L. (2001). Cross-sectional estimation of dynamic structural equation models in disequilibrium. In R. Cudeck, S. Du Toit, & D. Sorbom (Eds.), *Structural equation modeling: Present and future* (pp. 315-339). Lincolnwood, IL: Scientific Software International.

Kaplan, S., & Tetrick, L. E. (2011). Workplace safety and accidents: An industrial and organizational psychology perspective. In S. Zedeck (Ed.), *APA handbook of industrial and organizational psychology* (Vol. 1, pp. 455-472). Washington, DC: American Psychological Association.

Kenny, D. A. (1979). *Correlation and causality*. New York, NY: John Wiley.

Kenny, D. A., Kaniskan, B., & McCoach, D. B. (2011). The performance of RMSEA in models with small degrees of freedom. Unpublished paper, University of Connecticut (cited by D. A. Kenny at http://www.davidakenny.net/cm/fit.htm).

Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). New York, NY: Guilford Press.

Lance, C. E., Dawson, B., Birkelbach, D., & Hoffman, B. J. (2010). Method effects, measurement error, and substantive conclusions. *Organizational Research Methods*, *13*, 435-455.

Lazarus, R. S., & Folkman, S. (1984). *Stress, coping, and adaptation*. New York, NY: Springer-Verlag.

Liberty Mutual Research Institute for Safety (2011). *Workplace safety index*. Retrieved January 17, 2012 from http://www.libertymutualgroup.com/omapps/ContentServer?pagename=LMGroup/Views/LMG&ft=2&fid=1138356633468&ln=en.

Lord, R. G., Diefendorff, J. M., Schmidt, A. M., & Hall, R. J. (2010). Self-regulation at work. *Annual Review of Psychology, 61*, 543-568.

Macalister, T. (April 30, 2010). BP’s Deepwater Horizon oil spill likely to cost more than Exxon Valdez. *The Guardian*. Retrieved January 12, 2012 from http://www.guardian.co.uk/environment/2010/apr/30/bp-cost-deepwater-horizon-spill.

Marteau, T. M., & Bekker, H. (1992). The development of a six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI). *British Journal of Clinical Psychology, 31*, 301-306.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*, 370-396.

Mathews, A., & MacLeod, C. (1985). Selective processing of threat cues in anxiety states. *Behavioral Research and Therapy, 23*, 563-569.

McCrae, R. R., & Costa, P. T. (1987). Validation of the Five-Factor Model of personality across instruments and observers. *Journal of Personality and Social Psychology, 52*, 81-90.

McLain, D. L. (1995). Responses to health and safety risk in the work environment. *Academy of Management Journal*, *38*, 1726-1743.

Meyer, G., & Lavin, M. A. (2005). Vigilance: The essence of nursing. *Online Journal of Issues in Nursing*. Retrieved January 12, 2012 from http://www.med.univaq.it/medicina/lo/5986/1122050827-the%20Essence%20of%20Nursing.pdf.

Miller, J. G. (1965). Living systems: Basic concepts. *Behavioral Science, 10*, 193-237.

Montag, I., & Comrey, A. I. (1987). Internality and externality as correlates of involvement in fatal driving accidents. *Journal of Applied Psychology, 72*, 339-343.

Morrow, P. C., & Crum, M. R. (1998). The effects of perceived and objective safety risk on employee outcomes. *Journal of Vocational Behavior, 53*, 300-313.

Muthén, L. K., & Muthén, B. O. (2010). Mplus 6.0 user's guide. Los Angeles, CA: Muthén & Muthén.

Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2011). Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. *Journal of Applied Psychology, 96,* 71-94.

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and injuries at the individual and group levels. *Journal of Applied Psychology, 91*, 946-953.

Newman, J. E., & Beehr, T. A. (1979). Personal and organizational strategies for handling job stress: A review of research and opinion. *Personnel Psychology, 32,* 1-43.

Ostroff, C., Kinicki, A. J., & Tamkins, M. M. (2003). Organizational culture and climate. In W. C. Borman, & D. R. Ilgen (Eds.), *Handbook of psychology: Industrial and organizational psychology* (Vol. 12, pp. 565-593). New York, NY: John Wiley.

Paulhus, D. L. (1991). Measurement and control of response bias. In J. P. Robinson, P. R. Shaver, & L. S. Wrightsman (Eds.), *Measures of personality and social psychological attitudes* (Vol. 1, pp. 17-59). New York, NY: Academic Press.

Paulhus, D. L., & Reid, D. B. (1991). Enhancement and denial in socially desirable responding. *Journal of Personality and Social Psychology, 60,* 307-317.

Perloff, L. (1983). Perceptions of vulnerability to victimization. *Journal of Social Issues, 39*, 41-61.

Pittman, T. S., & Zeigler, K. R. (2007). Basic human needs. In A. W. Kruglanski & E. T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (2nd ed, pp. 473-489). New York, NY: Guilford Press.

Podsakoff, P., MacKenzie, S., Lee, J., & Podsakoff, N. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*, 879-903.

Pyszczynski, T., Greenberg, J., & Solomon, S. (1997). Why do we need what we need? A terror management perspective on the roots of human social motivation. *Psychological Inquiry, 8*, 1-20.

Reason, J. (1990). *Human Error*. Cambridge: Cambridge University Press.

Reason, J. (1995). A systems approach to organizational error. *Ergonomics, 38*, 1708-1721.

Reason, J. (2000). Human error: Models and management. *British Medical Journal, 320*, 768-770.

Robinson, S. L., & Morrison, E. W. (1995). Psychological contracts and OCB: The effect of unfulfilled obligations on civic virtue behavior. *Journal of Organizational Behavior, 16*, 289-298.

Rochlin, G. I. (1999). Safe operation as a social construct. *Ergonomics, 42*, 1549-1560.

Rogers, R. W. (1983). Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. *Social Psychophysiology*, 153-176.

Rogers, R. W., & Mewborn, C. R. (1976). Fear appeals and attitude change: Effects of a threat's noxiousness, probability of occurrence, and the efficacy of coping responses. *Journal of Personality and Social Psychology, 34*, 54-61.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs, 80*, 1-28.

Rotter, J. B. (1975). Some problems and misconceptions related to the construct of internal versus external control and reinforcement. *Journal of Consulting and Clinical Psychology, 43*, 56-67.

Schmitt, N., & Oswald, F. L. (2006). The impact of corrections for faking on the validity of noncognitive measures in selection settings. *Journal of Applied Psychology, 91*, 613-621.

Scott, L. D., Rogers, A. E., Hwang, W., & Zhang, Y. (2006). Effects of critical care nurses' work hours on vigilance and patients' safety. *American Journal of Critical Care, 15*, 30-37.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, MA: Houghton Mifflin and Company.

Slovic, P. (1987). Perception of risk. *Science, 236*, 280-285.

Spector, P. E. (2002). Research methods in industrial and organizational psychology: Data collection and data analysis with special consideration to international issues. In N. Anderson, D. S. Ones, H. K. Sinangil, & V. Chockalingam (Eds.), *Handbook of industrial, work and organizational psychology* (Vol. 1, pp. 10-26). Thousand Oaks, CA: Sage Publications.

Spector, P. E. (2006). Method variance in organizational research: Truth or urban legend? *Organizational Research Methods, 9*, 221-232.

Spielberger, C. D., Gorsuch, R. C., & Lushene, R. E. (1970). *Manual for the state-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press.

Stone-Romero, E. F. (2011). Research strategies in industrial and organizational psychology: Nonexperimental, quasi-experimental, and randomized experimental research in special purpose and nonspecial purpose settings. In S. Zedeck (Ed.), *APA handbook of industrial and organizational psychology* (Vol. 1, pp. 37-72). Washington, DC: American Psychological Association.

Tarrants, W. E. (1970). A definition of the safety measurement problem. *Journal of Safety Research, 2*, 106-108.

Tay, L., & Diener, E. (2011). Needs and subjective well-being around the world. *Journal of Personality and Social Psychology, 101*, 354-365.

Wallston, B. S., Wallston, K. A., Kaplan, G. D., & Maides, S. A. (1976). Development and validation of the Health Locus of Control (HLC) Scale. *Journal of Consulting and Clinical Psychology, 44*, 580-585.

Wang, Q., Bowling, N. A., & Eschleman, K. J. (2010). A meta-analytic examination of work and general locus of control. *Journal of Applied Psychology, 95*, 761-768.

Weinstein, N. D. (2000). Perceived probability, perceived severity, and health-protective behavior. *Health Psychology, 19*, 65-74.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology and Psychology, 18*, 459-482.

Zerbe, W. J., & Paulhus, D. L. (1987). Socially desirable responding in organizational behavior: A reconception. *Academy of Management Review, 12*, 250-264.

Zohar, D. (2000). A group-level model of safety climate: Testing the effect of group climate on microinjuries in manufacturing jobs. *Journal of Applied Psychology, 85*, 587-596.

Zohar, D. (2003). Safety climate: Conceptual and measurement issues. In J. C. Quick & L. E Tetrick (Eds.), *Handbook of Occupational Health Psychology,* (pp. 123-142). Washington, DC: American Psychological Association.

Zohar, D. (2008). Safety climate and beyond: A multi-level multi-climate framework. *Safety Science, 46*, 376-387.

APPENDIX A

VARIABLE MEAN COMPARISONS OF EMPLOYEES WHO DID AND DID NOT REPORT IDENTIFICATION NUMBERS

	Site 1		**Site 2**		**Site 3**	
Variable	Yes (*N* = 161)	No (*N* = 29)	Yes (*N* = 88)	No (*N* = 63)	Yes (*N* = 161)	No (*N* = 29)
Psych. Safety climate	3.67	3.51	4.00	3.81	**3.95***	**3.80**
Job risk	2.71	2.99	2.92	3.04	2.94	2.92
Trait anxiety	2.54	2.61	2.45	2.43	2.44	2.48
Int. LOC	3.72	3.63	**3.98***	**3.75**	3.79	3.63
Ext. LOC	2.68	2.90	2.36	2.55	2.53	2.62
Safety knowledge	4.34	4.32	4.13	4.24	4.50	4.40
Perceived safety	**3.95***	**3.62**	4.25	4.09	**3.98***	**3.77**
Safety anxiety	1.63	1.81	1.43	1.51	1.55	1.60
Safety compliance	4.19	4.10	**4.51***	**4.32**	4.45	4.35
Safety participation	3.82	3.71	4.16	4.08	4.05	4.11
Impression management	3.83	3.77	4.01	3.91	3.87	3.80

Notes. Mean comparisons were made using independent samples t-tests; bolded values represent mean comparisons that were statistically significant. *p < .05, two-tailed.

APPENDIX B

LIST OF VARIABLES ASSESSED AND THEIR SOURCES, RATING SCALES, AND ITEMS

(presented in alphabetical order based on variable name)

Dutifulness (International Personality Item Pool [IPIP] items assessing Costa & McCrae's [1992] NEO-PI-R dutifulness facet; Instructions asked respondents to describe how accurately the statements below describe them using a 1-5 scale with anchors corresponding to "Very inaccurate," "Moderately inaccurate," Neither inaccurate nor accurate," "Moderately accurate," and "Very accurate," respectively)

1. Believe laws should be strictly enforced.
2. Try to follow the rules.
3. Respect authority
4. Stick to the rules.
5. Do things by the book.
6. Follow directions.

Impression management (IPIP items; Instructions asked respondents to describe how accurately the statements below describe them using a 1-5 scale with anchors corresponding to "Very inaccurate," "Moderately inaccurate," Neither inaccurate nor accurate," "Moderately accurate," and "Very accurate," respectively)

1. Believe there is never an excuse for lying.
2. Always admit it when I make a mistake.
3. Rarely overindulge.
4. Have sometimes had to tell a lie. (R)

Job satisfaction (Agho, Price, & Mueller, 1992)
(1-7 scale ranging from "strongly disagree" to "strongly agree")

1. I find real enjoyment in my job.
2. I like my job better than the average person.
3. I am seldom bored with my job.
4. I would not consider taking another kind of job.
5. Most days I am enthusiastic about my job.
6. I feel fairly well satisfied with my job.

Knowledge of injuries (created for this study)

1. How many times have you been injured in this job?
2. How many times have you personally witnessed a co-worker get injured in this job?
3. How many co-worker injuries have you learned about in this job that you did not personally witness?

Life satisfaction (Diener, Emmons, Larsen, & Griffin, 1985)
(1-7 scale ranging from "strongly disagree" to "strongly agree")

1. In most ways my life is close to ideal.

2. The conditions of my life are excellent.
3. I am satisfied with my life.
4. So far I have gotten the important things I want in life.
5. If I could live my life over, I would change almost nothing.

Perceived job risk (Jermier, Gaines, & McIntosh, 1989)
(1-5 scale ranging from "almost always untrue" to "almost always true")
1. I encounter personally hazardous situations while at work.
2. My job is physically dangerous.
3. I am directly exposed to physical harm in carrying out my job.

Perceived safety (created for this study)
(1-5 scale ranging from "strongly disagree" to "strongly agree")
1. I feel safe at my workplace.
2. I do not worry about being injured when I am at work.
3. I am confident that I am safe when I am at work.
4. I feel that I am free from harm at my workplace.
5. My need for safety is fulfilled at work.
6. At work, my need for safety is satisfied.

Psychological contract fulfillment (derived from Robinson & Morrison, 2000 to be safety-specific)
(1-5 scale ranging from "strongly disagree" to "strongly agree")
1. My employer has kept its promise to uphold workplace safety.
2. I feel that my employer has come through in fulfilling its responsibility to provide a safe working environment.
3. My employer has failed in its obligation to provide a safe working environment. (R)
4. So far my employer has done an excellent job of meeting its obligation to ensure a safe workplace.

Psychological safety climate (Beus, Payne, & Arthur, 2011)
(1-5 scale ranging from "strongly disagree" to "strongly agree")
<u>Management commitment to safety</u>:
1. My supervisor strictly enforces the safe working procedures in my workgroup.
2. My supervisor takes a proactive stance when it comes to safety.
3. My supervisor demonstrates leadership by keeping people focused on safety.
4. My supervisor takes the lead on safety issues.
5. My supervisor is committed to improving safety.
6. My supervisor places a strong emphasis on workplace health and safety.

<u>Safety communication</u>:
7. Safety problems are openly discussed between my supervisor and my workgroup.
8. My workgroup gets timely feedback on safety issues we have raised with our supervisor.
9. My supervisor keeps my workgroup informed of safety rules.

10. Changes in procedures and their effects on safety are effectively communicated by my supervisor.

Safety training:

11. There is adequate safety training in my workgroup.
12. My supervisor provides safety training when employees change work tasks.
13. My supervisor invests a lot of time in employee safety training.
14. My supervisor trains employees to be safe.

Coworker safety practices:

15. My co-workers always follow safety procedures.
16. My co-workers are quick to point out unsafe conditions.
17. My co-workers take safety very seriously.
18. My co-workers are committed to safety improvement.

Safety equipment/housekeeping:

19. My supervisor provides sufficient safety equipment for employees.
20. My supervisor provides safe working conditions.
21. My supervisor checks equipment to make sure it is free of faults.
22. Unsafe conditions are promptly corrected in my work area.

Safety involvement:

23. My supervisor consults with employees regularly about workplace health and safety issues.
24. My supervisor promotes employees' involvement in safety related matters.
25. My supervisor values employees' ideas about improving safety and health.
26. My supervisor encourages employees to become involved in safety matters.

Safety rewards:

27. The reward system in my workgroup promotes high performance only when work is conducted safely.
28. My supervisor rewards safe behaviors.
29. My supervisor praises safe work behavior.
30. In my workgroup, employees who work safely get recognition.

Safety compliance (self-reported; Griffin & Neal, 2000)
(1-5 scale ranging from "strongly disagree" to "strongly agree")

1. I carry out my work in a safe manner.
2. I use all the necessary safety equipment to do my job.
3. I use the correct safety procedures for carrying out my job.
4. I ensure the highest levels of safety when I carry out my job.

Safety compliance (foreman-reported; Griffin & Neal, 2000)
(1-5 scale ranging from "strongly disagree" to "strongly agree")

1. This employee carries out his/her work in a safe manner.
2. This employee uses all the necessary safety equipment to do his/her job.
3. This employee uses the correct safety procedures for carrying out his/her job.
4. This employee ensures the highest levels of safety when s/he carries out his/her job.

Safety knowledge (self-reported; items 1-4, Griffin & Neal, 2000; items 5 and 6, added by the participating organization)
(1-5 scale ranging from "strongly disagree" to "strongly agree")
1. I know how to perform my job in a safe manner.
2. I know how to use safety equipment and standard work procedures.
3. I know how to maintain or improve workplace health and safety.
4. I know how to reduce the risk of accidents and incidents in the workplace.
5. I know which safety requirements apply to my work.
6. I know where to find company safety procedures.

Safety knowledge (foreman-reported; items 1-4, Griffin & Neal, 2000; items 5 and 6, added by the participating organization)
(1-5 scale ranging from "strongly disagree" to "strongly agree")
1. This employee knows how to perform his/her job in a safe manner.
2. This employee knows how to use safety equipment and standard work procedures.
3. This employee knows how to maintain or improve workplace health and safety.
4. This employee knows how to reduce the risk of accidents and incidents in the workplace.
5. This employee knows which safety requirements apply to his/her work.
6. This employee knows where to find company safety procedures.

Safety locus of control (Jones & Wuebker, 1985; items 1-6, safety internality; items 7-12, safety externality; items 13-15, powerful others – not incorporated in analyses)
(1-5 scale ranging from "Strongly disagree" to "Strongly agree")
1. Industrial accidents are due to employee carelessness.
2. Most on-the-job accidents and injuries result from employees' mistakes.
3. Most accidents are avoidable.
4. Most accidents and injuries at work can be avoided.
5. Occupational accidents and injuries occur because employees do not take enough interest in safety.
6. Most of my accidental injuries are preventable.
7. I think I am a victim of misfortune whenever I have an accident.
8. No matter how hard employees try to prevent them, there will always be on-the-job accidents.
9. For me avoiding accidents is a matter of luck.
10. There are so many dangers in this world that I never know how or when I might be in an accident.
11. With my luck, I will probably have an accident in the near future.
12. The odds are in favor of me having an accident in the near future.
13. Industrial accidents are usually caused by unsafe equipment and poor safety regulations.
14. Most on-the-job accidents can be blamed on poor management.
15. It is the company's responsibility to prevent all accidents at work.

Safety participation (self-reported; 1-4, Griffin & Neal, 2000; item 5 was added by the participating organization – this item was not included for this study's analyses)
(1-5 scale ranging from "strongly disagree" to "strongly agree")

1. I promote the safety program within the organization.
2. I put in extra effort to improve the safety of the workplace.
3. I help my coworkers when they are working under risky or hazardous conditions.
4. I voluntarily carry out tasks or activities that help to improve workplace safety.
5. I am comfortable stopping a work task if I see unsafe acts or risky operations.

Safety participation (foreman-reported; 1-4, Griffin & Neal, 2000; item 5 was added by the participating organization – this item was not included for this study's analyses)
(1-5 scale ranging from "strongly disagree" to "strongly agree")

1. This employee promotes the safety program within the organization.
2. This employee puts in extra effort to improve the safety of the workplace.
3. This employee helps his/her coworkers when they are working under risky or hazardous conditions.
4. This employee voluntarily carries out tasks or activities that help to improve workplace safety.
5. This employee is comfortable stopping a work task if s/he sees unsafe acts or risky operations.

Safety threshold (created for this study)
(1-5 scale ranging from "strongly disagree" to "strongly agree")

1. It is important for me to feel safe at work.
2. I need to feel safe to do my best at work.
3. When working, it is critical to feel safe.

Safety-related anxiety (Marteau & Bekker's [1992] short version of Spielberger, Gorsuch, & Lushene's [1970] State-Trait Anxiety Inventory [STAI])
(Instructions specified for respondents to indicate the extent to which the following statements are generally true of them with regard to their safety at work; 1-4 scale with anchors corresponding to "Not at all," "Somewhat," "Moderately," and "Very much," respectively)

1. I feel calm. (R)
2. I am tense.
3. I feel upset.
4. I am relaxed. (R)
5. I feel content. (R)
6. I am worried.

Trait anxiety (IPIP representation of Costa & McCrae's [1992] NEO-PI-R anxiety facet; Instructions asked respondents to describe how accurately the statements below described them using a 1-5 scale with anchors corresponding to "Very inaccurate," “Moderately inaccurate,” Neither inaccurate nor accurate,” “Moderately accurate,” and “Very accurate,” respectively)

1. Worry about things.
2. Fear for the worst.
3. Am afraid of many things.
4. Get stressed out easily.
5. Get caught up in my problems.
6. Am not easily bothered by things. (R)
7. Am relaxed most of the time. (R)
8. Am not easily disturbed by events. (R)
9. Don’t worry about things that have already happened. (R)
10. Adapt easily to new situations. (R)

APPENDIX C

DESCRIPTIVE STATISTICS AND VARIABLE INTER-CORRELATIONS FOR ALL 3 PARTICIPATING SITES

Variable	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Psychological safety climate	3.81	0.62	(.88)								
2. Trait anxiety	2.49	0.65	-.20*	(.81)							
3. Dutifulness	4.26	0.64	.34*	-.20*	(.92)						
4. Impression management	3.87	0.66	.22*	-.20*	.50*	(.62)					
5. Safety knowledge	4.34	0.50	.41*	-.22*	.40*	.26*	(.78)				
6. Job risk	2.88	0.99	-.02	.09*	-.04	-.05	.09*	(.73)			
7. Safety threshold	4.26	0.69	.25*	-.02	.33*	.22*	.30*	.11*	(.84)		
8. Internal locus of control	3.75	0.65	.13*	-.01	.25*	.15*	.18*	.03	.22*	(.84)	
9. External locus of control	2.58	0.61	-.14*	.33*	-.22*	-.18*	-.12*	.19*	-.05	-.10*	(.73)
10. Perceived safety	3.96	0.66	.38*	-.23*	.25*	.17*	.24*	-.26*	.15*	.25*	-.21*
11. Safety anxiety	1.57	0.50	-.26*	.42*	-.14*	-.13*	-.16*	.23*	.00	-.05	.29*
12. Job satisfaction	5.05	1.14	.32*	-.30*	.30*	.27*	.21*	-.10*	.24*	.21*	-.17*
13. Life satisfaction	4.87	1.14	.27*	-.30*	.25*	.23*	.13*	-.11*	.16*	.14*	-.14*
14. Psychological contract fulfillment	4.09	0.66	.55*	-.18*	.35*	.14*	.24*	-.16*	.19*	.22*	-.29*
15. Safety compliance	4.34	0.59	.50*	-.17*	.51*	.29*	.54*	-.01	.33*	.27*	-.23*
16. Safety participation	4.08	0.64	.46*	-.12*	.33*	.23*	.43*	.14*	.25*	.25*	-.16*
17. Knowledge of injuries	3.03	7.60	-.12*	-.02	-.12*	-.03	.03	.10*	-.11*	-.11*	.07
18. Experienced injuries	0.34	1.19	-.04	.03	-.07	.02	.04	.14*	-.03	-.15*	.13*
19. Witnessed injuries	0.63	2.57	-.08	-.01	-.08	.00	.00	.05	-.06	-.05	.01
20. Learned injuries	2.12	5.21	-.13*	-.03	-.13*	-.05	.03	.09*	-.12*	-.10*	.06

Notes. These numbers are based on 595 employee responses across all 3 participating sites. Numbers in parentheses along the diagonal are coefficient alphas; $N = 75$ for foremen-rated variables. $^{*}p \leq .05$, two-tailed.

APPENDIX C continued…

Variable	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
21. Age	41.97	4.73	-.07	.10*	.04	.07	.12*	.06	.10*	-.01	.04
22. Job experience	14.79	12.52	-.08	.10*	-.07	.00	.10	.00	.04	.00	.05
23. Tenure	7.55	9.21	-.07	.10*	-.11*	.03	.05	.07	.01	-.06	.12*
24. Hours worked per week	41.79	4.73	.06	-.02	.02	.02	.03	.00	-.08	.00	-.07
Foremen-rated variables											
25. Opportunity to observe	4.16	0.87	.03	-.09	.22	.00	.06	.08	.21	-.01	.13
26. Safety knowledge	4.40	0.58	.00	-.02	.07	-.07	-.06	.14	.10	.03	.03
27. Safety compliance	4.45	0.56	.07	-.08	.18	.01	-.02	.14	.18	.01	.01
28. Safety participation	4.16	0.65	-.10	.07	.04	-.08	-.10	.10	.06	.01	.10

Notes. These numbers are based on 595 employee responses across all 3 participating sites. Numbers in parentheses along the diagonal are coefficient alphas; N = 75 for foremen-rated variables. *$p \leq .05$, two-tailed.

APPENDIX C continued…

Variable	*M*	*SD*	10	11	12	13	14	15	16	17	18
10. Perceived safety	3.96	0.66	(.90)								
11. Safety anxiety	1.57	0.50	-.36*	(.80)							
12. Job satisfaction	5.05	1.14	.31*	-.34*	(.87)						
13. Life satisfaction	4.87	1.14	.31*	-.37*	.58*	(.86)					
14. Psychological contract fulfillment	4.09	0.66	.56*	-.37*	.33*	.33*	(.83)				
15. Safety compliance	4.34	0.59	.40*	-.26*	.38*	.28*	.56*	(.92)			
16. Safety participation	4.08	0.64	.25*	-.12*	.25*	.18*	.39*	.62*	(.86)		
17. Knowledge of injuries	3.03	7.60	-.14*	.17*	-.15*	-.13*	-.17*	-.10*	-.09	--	
18. Experienced injuries	0.34	1.19	-.13*	.23*	-.14*	-.12*	-.14*	-.09*	-.05	.46*	--
19. Witnessed injuries	0.63	2.57	-.07	.08	-.08	-.07	-.14*	-.05	-.03	.80*	.21*
20. Learned injuries	2.12	5.21	-.13*	.14*	-.13*	-.12*	-.15*	-.09*	-.10*	.95*	.34*
21. Age	41.97	4.73	-.08	.16*	.11*	-.03	-.07	.04	.08	.15*	.21*
22. Job experience	14.79	12.52	-.09*	.15*	.06	-.07	-.11*	-.01	.05	.22*	.24*
23. Tenure	7.55	9.21	-.09*	.13*	.01	-.06	-.15*	-.07	-.02	.30*	.32*
24. Hours worked per week	41.79	4.73	.02	-.05	.06	.01	.06	.03	.07	-.01	-.08
Foremen-rated variables											
25. Opportunity to observe	4.16	0.87	.14	.00	.00	-.04	.02	-.04	.16	.10	.01
26. Safety knowledge	4.40	0.58	.20	-.11	.09	.03	.12	.02	.25*	.08	.05
27. Safety compliance	4.45	0.56	.19	-.11	.09	.11	.14	.05	.22	.01	-.07
28. Safety participation	4.16	0.65	.15	-.09	.03	-.08	.13	-.05	.08	.09	.04

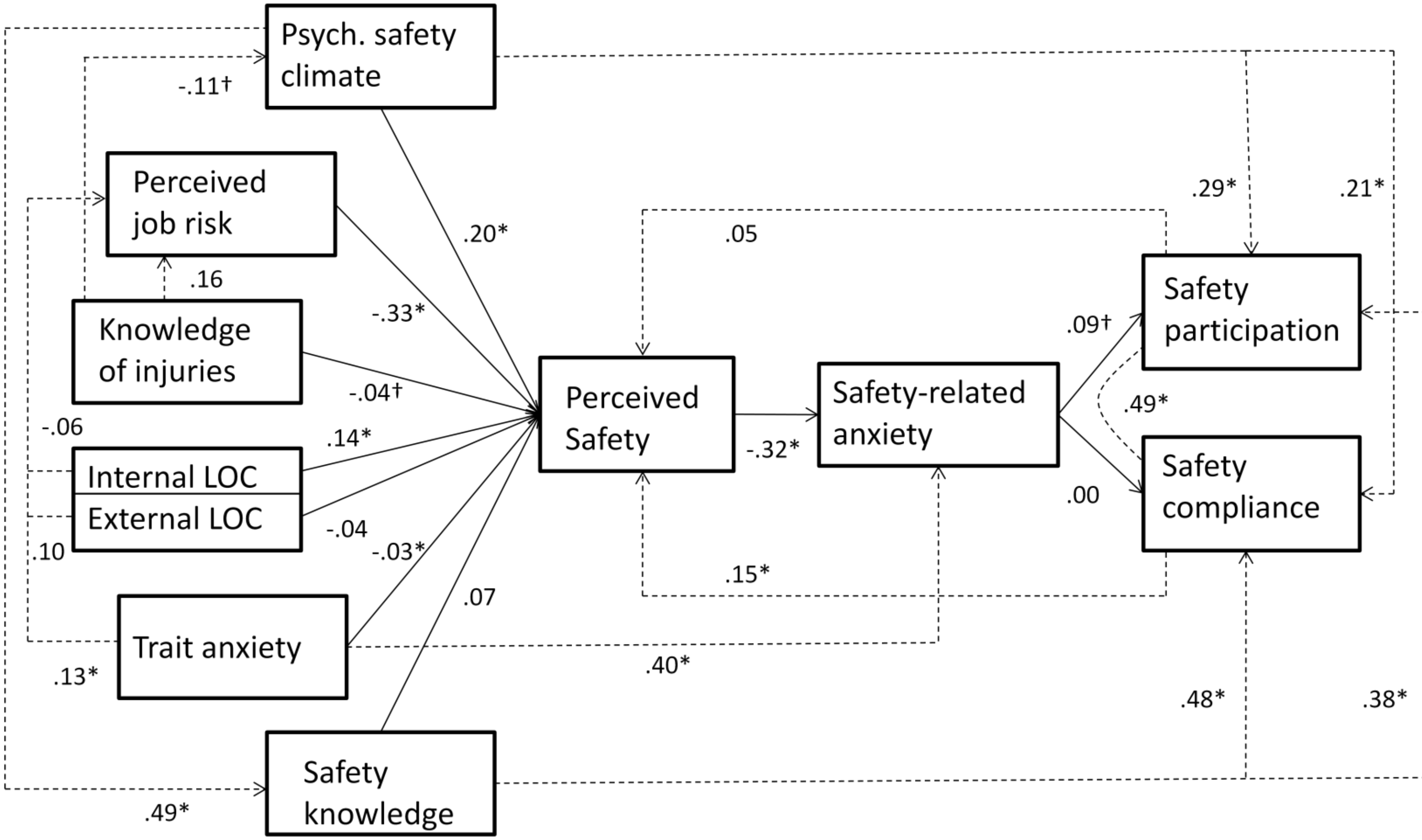
Notes. These numbers are based on 595 employee responses across all 3 participating sites. Numbers in parentheses along the diagonal are coefficient alphas; $N = 75$ for foremen-rated variables. $^*p \leq .05$, two-tailed.

APPENDIX C continued…

Variable	*M*	*SD*	19	20	21	22	23	24	25	26	27	28
19. Witnessed injuries	.63	2.57	--									
20. Learned injuries	2.12	5.21	.61*	--								
21. Age	41.97	4.73	.12*	.12*	--							
22. Job experience	14.79	12.52	.18*	.18*	.76*	--						
23. Tenure	7.55	9.21	.23*	.25*	.55*	.65*	--					
24. Hours worked per week	41.79	4.73	-.02	.01	.03	.11*	.01	--				
Foremen-rated variables												
25. Opportunity to observe	4.16	0.87	.13	.05	-.04	-.04	-.03	.28*	--			
26. Safety knowledge	4.40	0.58	.12	.01	-.02	-.02	-.01	.23	.78*	(.95)		
27. Safety compliance	4.45	0.56	.06	-.01	-.10	-.09	-.13	.14	.74*	.83*	(.94)	
28. Safety participation	4.16	0.65	.14	.02	-.04	-.07	.00	.24*	.64*	.83*	.65*	(.87)

Notes. These numbers are based on 595 employee responses across all 3 participating sites; Numbers in parentheses along the diagonal are coefficient alphas; N = 75 for foremen-rated variables. $*p \leq .05$, two-tailed.

APPENDIX D


Psych. safety climate
Perceived job risk
Knowledge of injuries
Internal LOC
External LOC
Trait anxiety
Safety knowledge
Perceived Safety
Safety-related anxiety
Safety participation
Safety compliance
-.11†
.16
-.06
.10
.13*
.49*
.20*
-.33*
-.04†
.14*
-.04
-.03*
.07
-.32*
.05
.15*
.40*
.09†
.00
.49*
.29*
.21*
.48*
.38*

Notes. Structural model results for all three sites combined (N = 508). Solid lines reflect hypothesized paths whereas dashed lines reflect non-hypothesized parameters; all estimates are standardized; standard errors were adjusted to account for employee nesting within sites. Results for model fit: $\chi^2(3{,}698) = 8{,}198.67$, CFI = .84, RMSEA = .05, SRMR = .10. *$p \leq .05$.

APPENDIX E

SAFETY-RELATED ANXIETY PREDICTING FOREMAN-RATED EMPLOYEE SAFETY BEHAVIORS FOR THE FULL SAMPLE

Variable	Safety compliance	Safety participation
Psychological safety climate	.09	-.18
Safety knowledge	-.05	-.13*
Safety-related anxiety	-.14	-.06

Notes. N = 595 (dependent variables N = 75). All table entries represent standardized estimates. Because these data were nested within three sites, standard errors were adjusted to reflect data non-independence. *$p \leq .05$.

APPENDIX F

PAPER-BASED SURVEY ADMINISTERED TO EMPLOYEES[7]

SAFETY SURVEY

Please carefully read through all of these instructions before starting this survey. The purpose of this survey is to assess a number of safety-related individual and workplace variables to help evaluate the safety level of your workplace. This study is being conducted by a team of researchers from Texas A&M University with the support of [redacted] management.

Introduction

The purpose of this first page is to provide you (as a prospective research study participant) information that may affect your decision as to whether or not to participate in this research. You have been asked to participate in a research study examining employees' safety perceptions in the workplace. You were selected to be a possible participant because you are a [redacted] employee.

What will I be asked to do? If you agree to participate, you will be asked to complete a survey which will take approximately 20 minutes to complete.

What are the risks involved in this study? The risks associated with this study are minimal and are not greater than the risks ordinarily encountered in daily life.

What are the possible benefits of this study?

The benefits you will receive by participating in this study include increased voice to your safety concerns and an enhanced understanding by the leadership teams on how safety in the workplace can be improved.

Do I have to participate? No. Your participation is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with [redacted] being affected.

[7] While the content of the survey is exactly the same as what was delivered to participants, the formatting has been altered to fit in this document. Specifically, the margins and some of the font sizes have been adjusted to fit content on these pages. The identity of the participating organization is being protected in accordance with a signed confidentiality statement.

Who will know about my participation in this research study?
All responses to this survey will be STRICTLY CONFIDENTIAL—individual responses will NOT be published in any form or provided to [redacted] representatives. To preserve confidentiality, the responses gathered in this study will only be analyzed by Texas A&M researchers and presented in aggregate form in all reports summarizing the findings. Information about you will be kept confidential to the extent permitted or required by law.

Whom do I contact with questions about the research?
If you have questions regarding this study, you may contact Jeremy Beus at (979) 862-8410 or jbeus@neo.tamu.edu or [redacted]

Whom do I contact about my rights as a research participant?
This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979) 458-4067 or irb@tamu.edu.

Participation. Please be sure you have read the above information, asked questions and received answers to your satisfaction.

Repetitive Questions
As you proceed through this survey you will note that many of the questions are highly similar. This was done intentionally. Please respond to each question honestly and to the best of your knowledge.

Definition of a Workgroup and Supervisor
For the purposes of this survey, a workgroup is defined as a group of employees who report to a common supervisor. Your supervisor is the person you directly report to (supervisor, manager, etc.), even if he/she is not referred to as a "supervisor." Related to this,

How many employees are in your current workgroup (including yourself, your supervisor, and the other workers who report to the same supervisor)?

__________ employees

SAFETY CLIMATE/CULTURE QUESTIONS

Thinking of your current workgroup, please read the statements listed below and mark the response that indicates the extent to which you agree with each statement.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. My supervisor strictly enforces the safe working procedures in my workgroup.	1	2	3	4	5
2. My supervisor takes a proactive stance when it comes to safety.	1	2	3	4	5
3. My supervisor demonstrates leadership by keeping people focused on safety.	1	2	3	4	5
4. My supervisor takes the lead on safety issues.	1	2	3	4	5
5. My supervisor is committed to improving safety.	1	2	3	4	5
6. My supervisor places a strong emphasis on workplace health and safety.	1	2	3	4	5
7. Safety problems are openly discussed between my supervisor and my workgroup.	1	2	3	4	5
8. My workgroup gets timely feedback on safety issues we have raised with our supervisor.	1	2	3	4	5

Thinking of your current workgroup, please read the statements listed below and mark the response that indicates the extent to which you agree with each statement.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
9. My supervisor keeps my workgroup informed of safety rules.	1	2	3	4	5
10. Changes in procedures and their effects on safety are effectively communicated by my supervisor.	1	2	3	4	5
11. There is adequate safety training in my workgroup.	1	2	3	4	5
12. My supervisor provides safety training when employees change work tasks.	1	2	3	4	5
13. My supervisor invests a lot of time in employee safety training.	1	2	3	4	5
14. My supervisor trains employees to be safe.	1	2	3	4	5
15. My co-workers always follow safety procedures.	1	2	3	4	5
16. My co-workers are quick to point out unsafe conditions.	1	2	3	4	5
17. My co-workers take safety very seriously.	1	2	3	4	5
18. My co-workers are committed to safety improvement.	1	2	3	4	5
19. My supervisor provides sufficient safety equipment for employees.	1	2	3	4	5
20. My supervisor provides safe working conditions.	1	2	3	4	5
21. My supervisor checks equipment to make sure it is free of faults.	1	2	3	4	5
22. Unsafe conditions are promptly corrected in my work area.	1	2	3	4	5
23. My supervisor consults with employees regularly about workplace health and safety issues.	1	2	3	4	5
24. My supervisor promotes employees’ involvement in safety related matters.	1	2	3	4	5

Thinking of your current workgroup, please read the statements listed below and mark the response that indicates the extent to which you agree with each statement.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
25. My supervisor values employees' ideas about improving safety and health.	1	2	3	4	5
26. My supervisor encourages employees to become involved in safety matters.	1	2	3	4	5
27. The reward system in my workgroup promotes high performance only when work is conducted safely.	1	2	3	4	5
28. My supervisor rewards safe behaviors.	1	2	3	4	5
29. My supervisor praises safe work behavior.	1	2	3	4	5
30. In my workgroup, employees who work safely get recognition.	1	2	3	4	5

PERSONALITY QUESTIONS

Read the following statements and indicate the extent to which each accurately describes you.	Very Inaccurate	Moderately Inaccurate	Neither Accurate nor Inaccurate	Moderately Accurate	Very Accurate
1. I worry about things.	1	2	3	4	5
2. I fear for the worst.	1	2	3	4	5
3. I am afraid of many things.	1	2	3	4	5
4. I get stressed out easily.	1	2	3	4	5
5. I get caught up in my problems.	1	2	3	4	5
6. I am not easily bothered by things.	1	2	3	4	5
7. I am relaxed most of the time.	1	2	3	4	5

8. I am not easily disturbed by events.	1	2	3	4	5
9. I don't worry about things that have already happened.	1	2	3	4	5
10. I adapt easily to new situations.	1	2	3	4	5
11. I believe laws should be strictly enforced.	1	2	3	4	5
12. I try to follow the rules.	1	2	3	4	5
13. I respect authority.	1	2	3	4	5
14. I stick to the rules.	1	2	3	4	5
15. I do things by the book.	1	2	3	4	5
16. I follow directions.	1	2	3	4	5
17. I believe there is never an excuse for lying.	1	2	3	4	5
18. I always admit it when I make a mistake.	1	2	3	4	5
19. I rarely overindulge.	1	2	3	4	5
20. I have sometimes had to tell a lie.	1	2	3	4	5

SAFETY ATTITUDES/PERCEPTIONS QUESTIONS

Please mark the response that indicates the extent to which you agree with each statement.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. I know how to perform my job in a safe manner.	1	2	3	4	5
2. I know how to use safety equipment and standard work procedures.	1	2	3	4	5
3. I know how to maintain or improve workplace health and safety.	1	2	3	4	5
4. I know how to reduce the risk of accidents and incidents in the workplace.	1	2	3	4	5
5. I know which safety requirements apply to my work.	1	2	3	4	5
6. I know where to find company safety procedures.	1	2	3	4	5
7. I encounter personally hazardous situations while at work.	1	2	3	4	5
8. My job is physically dangerous.	1	2	3	4	5
9. I am directly exposed to safety risks in carrying out my job.	1	2	3	4	5
10. It is important for me to feel safe at work.	1	2	3	4	5
11. I need to feel safe to do my best at work.	1	2	3	4	5
12. When working, it is critical to feel safe.	1	2	3	4	5
13. Industrial accidents are due to employee carelessness.	1	2	3	4	5
14. Most on-the-job accidents and injuries result from employees’ mistakes.	1	2	3	4	5
15. Most accidents are avoidable.	1	2	3	4	5
16. Most accidents and injuries at work can be avoided.	1	2	3	4	5
17. Occupational accidents and injuries occur because employees do not take enough interest in safety.	1	2	3	4	5

Please mark the response that indicates the extent to which you agree with each statement.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
18. Most of my accidental injuries are preventable.	1	2	3	4	5
19. I think I am a victim of misfortune whenever I have an accident.	1	2	3	4	5
20. No matter how hard employees try to prevent them, there will always be on-the-job accidents.	1	2	3	4	5
21. For me, avoiding accidents is a matter of luck.	1	2	3	4	5
22. There are so many dangers in this world that I never know how or when I might be in an accident.	1	2	3	4	5
23. With my luck, I will probably have an accident in the near future.	1	2	3	4	5
24. The odds are in favor of me having an accident in the near future.	1	2	3	4	5
25. Industrial accidents are usually caused by unsafe equipment and poor safety regulations.	1	2	3	4	5
26. Most on-the-job accidents can be blamed on poor management.	1	2	3	4	5
27. It is the company's responsibility to prevent all accidents at work.	1	2	3	4	5
28. I feel safe at my workplace.	1	2	3	4	5
29. I do not worry about being injured when I am at work.	1	2	3	4	5
30. My need for safety is fulfilled at work.	1	2	3	4	5
31. I am confident that I am safe when I am at work.	1	2	3	4	5
32. I feel that I am free from harm at my workplace.	1	2	3	4	5
33. At work, my need for safety is satisfied.	1	2	3	4	5

Please indicate the extent to which the following statements are true with regard to your safety at work.	Not at all	Somewhat	Moderately	Very much
1. I feel calm.	1	2	3	4
2. I am tense.	1	2	3	4
3. I feel upset.	1	2	3	4
4. I am relaxed.	1	2	3	4
5. I feel content.	1	2	3	4
6. I am worried.	1	2	3	4

Please mark the response that indicates the extent to which you agree with each statement.	Strongly Disagree	Disagree	Somewh at Disagree	Neither Disagree nor Agree	Somewh at Agree	Agree	Strongly Agree
1. I find real enjoyment in my job.	1	2	3	4	5	6	7
2. I like my job better than the average person.	1	2	3	4	5	6	7
3. I am seldom bored with my job.	1	2	3	4	5	6	7
4. I would not consider taking another kind of job.	1	2	3	4	5	6	7
5. Most days I am enthusiastic about my job.	1	2	3	4	5	6	7
6. I feel fairly well satisfied with my job.	1	2	3	4	5	6	7
7. In most ways my life is close to ideal.	1	2	3	4	5	6	7
8. The conditions of my life are excellent.	1	2	3	4	5	6	7
9. I am satisfied with my life.	1	2	3	4	5	6	7
10. So far I have gotten the important things I want in life.	1	2	3	4	5	6	7
11. If I could live my life over, I would change almost nothing.	1	2	3	4	5	6	7

Please mark the response that indicates the extent to which you agree with each statement.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. My employer has kept its promise to uphold workplace safety.	1	2	3	4	5
2. I feel that my employer has come through in fulfilling its responsibility to provide a safe working environment.	1	2	3	4	5
3. My employer has failed in its obligation to provide a safe working environment.	1	2	3	4	5
4. So far my employer has done an excellent job of meeting its obligation to ensure a safe workplace.	1	2	3	4	5
5. I carry out my work in a safe manner.	1	2	3	4	5
6. I use all the necessary safety equipment to do my job.	1	2	3	4	5
7. I use all the correct safety procedures for carrying out my job.	1	2	3	4	5
8. I ensure the highest levels of safety when I carry out my job.	1	2	3	4	5
9. I promote the safety program within the organization.	1	2	3	4	5
10. I put in extra effort to improve the safety of the workplace.	1	2	3	4	5
11. I help my co-workers when they are working under risky or hazardous conditions.	1	2	3	4	5
12. I voluntarily carry out tasks or activities that help to improve workplace safety.	1	2	3	4	5
13. I am comfortable stopping a work task if I see unsafe acts or risky operations.	1	2	3	4	5

Please proceed to the next page to complete a brief Demographics section

DEMOGRAPHIC QUESTIONS

As noted, all responses to this survey will be STRICTLY CONFIDENTIAL. We ask that you please provide your employee identification number in the space provided below to allow Texas A&M researchers to combine responses to certain work groups. All responses will be securely stored by the Texas A&M researchers and will only be analyzed and presented in aggregate form such that individual responses cannot be identified.

1. Employee Identification Number: ____________

2. Age: ______ years

3. Sex: Male Female (circle one)

4. Approximately how many years of work experience do you have in your career/field? _____ years

5. How long have you worked in your current job? _____ years

6. On average, how many hours do you work per week in this job? ______ hours

7. Do you currently hold a supervisory or managerial position in this job? Yes No (circle one)

8. If yes, how many people do you supervise? ______ people

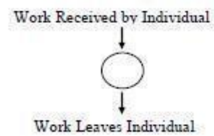
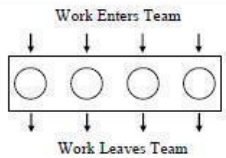
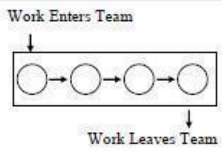
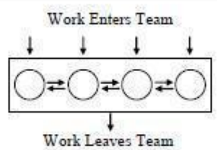
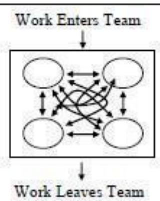
9. How many times have you been injured in this job? __________

10. How many times have you personally witnessed a co-worker get injured in this job? __________

11. How many co-worker injuries have you learned about in this job that you did not personally witness? ____________

Instructions: The diagram below illustrates several workflow patterns. Please read the description for each illustration and answer the question below considering the workflow pattern in your current workgroup.

Which of the illustrations below best characterizes the way that work flows between members of your workgroup in order to successfully perform your job? ________ (1, 2, 3, 4, or 5)

① 	**Not a Team Task/Activity**
② 	**Pooled/Additive Interdependence**
③ 	**Sequential Interdependence**
④ 	**Reciprocal Interdependence**
⑤ 	**Intensive Interdependence**

Thank you for completing this survey

APPENDIX G
COMPUTER-BASED SURVEY ADMINISTERED TO FOREMEN[8]

Safety survey - Supervisors

Exit this survey

Survey Instructions

<u>Please carefully read through all of these instructions before starting this survey</u>. The purpose of this survey is to have you rate the safety knowledge and safety performance of the employees you supervise. This is in conjunction with the recently-administered safety survey conducted by Texas A&M University Researchers with support from [redacted] management.

You will be asked to individually rate the safety knowledge and performance of <u>each of your employees who participated in this safety survey</u> and should have received a list indicating who these employees are prior to receiving the invitation to participate in this survey. You will need to input these employees' respective employee identification numbers to successfully complete this survey. If you have not received this information please contact [redacted]

Please note that all responses to this survey will be STRICTLY CONFIDENTIAL; individual responses will NOT be published in any form or provided to [redacted] representatives. To preserve confidentiality, the responses gathered in this study will only be analyzed by the Texas A&M researchers and presented in aggregate form in all reports summarizing the findings. Information you provide will be kept confidential to the extent permitted or required by law.

If you have questions regarding this study, you may contact Jeremy Beus at (979) 862-8410 or jbeus@neo.tamu.edu or [redacted].

If you choose to participate, please click "next" to proceed in rating your employees. We ask that you respond to these questions to the best of your knowledge.

Next

[8] Survey content has been pasted from the online survey into this document. Because of this there have been some minor formatting changes. The identity of the participating organization is being protected in accordance with a signed confidentiality statement. Skip logic embedded in the online survey allowed foremen the opportunity to rate from 1 to 20 employees on the set of items listed below. If they answered "No" to question 3 "Do you have another employee to rate?", they were directed to the demographics page.

Safety survey - Supervisors

Exit this survey

Rating Employee Safety Knowledge and Performance (Employee #1)

1. Please enter the employee ID# for the employee you are currently rating.

employee ID#

2. Please mark the extent to which you agree with the following statements with regard to this specific employee.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have had sufficient opportunity to observe this employee's safety performance.	○	○	○	○	○
This employee knows how to perform his/her job in a safe manner.	○	○	○	○	○
This employee knows how to use safety equipment and standard work procedures.	○	○	○	○	○
This employee knows how to maintain or improve workplace health and safety.	○	○	○	○	○
This employee knows how to reduce the risk of accidents and incidents in the workplace.	○	○	○	○	○
This employee knows which safety requirements apply to his/her work.	○	○	○	○	○
This employee knows where to find company safety procedures.	○	○	○	○	○
This employee carries out his/her work in a safe manner.	○	○	○	○	○
This employee uses all the necessary safety equipment to do his/her job.	○	○	○	○	○
This employee uses all the correct safety procedures for carrying out his/her job.	○	○	○	○	○
This employee ensures the highest levels of safety when s/he carries out his/her job.	○	○	○	○	○
This employee promotes the safety program within the organization.	○	○	○	○	○
This employee puts in extra effort to improve the safety of the workplace.	○	○	○	○	○
This employee helps his/her co-workers when they are working under risky or hazardous conditions.	○	○	○	○	○
This employee voluntarily carries out tasks or activities that help to improve workplace safety.	○	○	○	○	○
This employee is comfortable stopping a work task if he/she sees unsafe acts or risky operations.	○	○	○	○	○

3. Do you have another employee to rate?

○ Yes

○ No

Prev Next

Safety survey - Supervisors

Exit this survey

Demographic Section

Please answer the following questions <u>about yourself</u>

4. What is your employee ID#?

employee ID#

5. Age

years

6. Sex

- Male
- Female

7. How many employees do you supervise?

employees

8. Approximately how long have you been in your current supervisor position?

years

9. How long have you worked for [redacted]?

years

Thank you for taking the time to complete this survey!

Prev

Done

VITA

Jeremy Mark Beus received his Bachelor of Science degree in psychology from Brigham Young University – Idaho in Rexburg, Idaho in 2007. He entered the industrial and organizational psychology program at Texas A&M University in September 2007 and received his Master of Science degree in May 2009. His research interests include occupational safety, organizational climate, organizational socialization, and job performance variability.

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